SCIENTIFIC AMERICAN SUPPLEMENT No. 159

Scientific American Supplement, Vol. VII., No. 159.
Scientific American, established 1845.

NEW YORK, JANUARY 18, 1879.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

FIRELESS LOCOMOTIVES IN FRANCE.

FIRELESS locomotives, similar to those running between New Orleans and Carrollton, La., have lately been introduced on the tramway line from Rueil to Marly (Paris, France), in order to test them thoroughly in regard to cost, capacity, etc., before adopting them universally for city passenger transportation.

In construction these locomotives do not differ essentially from those built by Mr. Lamm for the New Orleans and Carrollton Railroad. They have, nevertheless, been variously improved by Mr. L. Francq.

The motive power of fireless locomotives is furnished by heat, stored up in the water which is contained in the reservoir corresponding to the boiler of an ordinary engine.

The water is fed into the reservoir from boilers located at Port Marly, at a temperature of about 390° Fahr., and the pressure in the freshly charged reservoir is equal to fifteen atmospheres. At every stroke of the piston a quantity of steam is removed from the reservoir. The pressure within the latter decreases consequently; the water commences to boil and more steam is generated till the equilibrium between the pressure and the expansive energy of the superheated water is again restored. In the original Lamm locomotives the pressure not only decreased in the reservoir but also in the cylinder, and this great difficulty has been overcome by Mr. L. Francq. From the dome forming the upper part of the reservoir the steam is conducted through a cylinder, in which, by a peculiar system of valves, a pressure of five atmospheres is always maintained, until the pressure in the reservoir has itself been reduced to that point. From the pressure regulator the steam is conducted by a tube passing transversely through the center of the reservoir to the working cylinder.

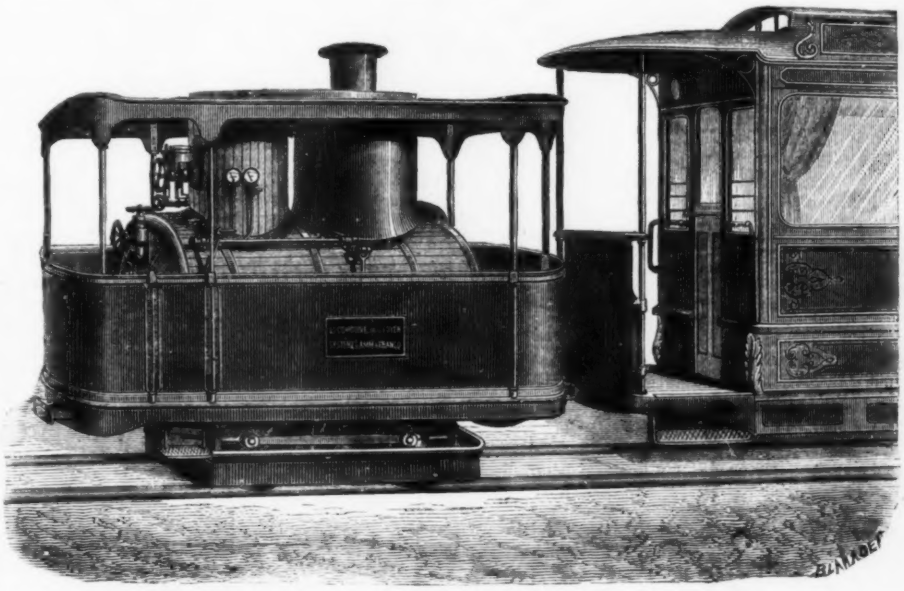
As all unnecessary noise must be avoided in a street locomotive, the exhaust steam is not allowed to escape, but condensed in a sort of surface condenser formed by vertical tubes exposed to the air.

The New Orleans engines were not provided with a platform for the engineer. The Francq locomotives are completely surrounded by a spacious platform, from which all parts of the machinery are easily accessible.

On the line Rueil-Marly the section from Rueil station to Port Marly is pretty level, presenting but few bends and elevations. From Port Marly to the Marly waterworks the elevation is considerable. The station at the waterworks is situated about 200 ft. higher than Port Marly station. On arriving at the latter place the pressure in the reservoir is nearly exhausted, and freshly charged locomotives are, therefore, used to pull the train up hill. A train generally consists, besides the locomotive, of a freight car, a "double-decker," and an ordinary street car. The locomotives are very light, as all parts necessitated by a fire could be dispensed with.

Some time ago compressed air engines were used on the same road, but they were discarded as being too expensive. The running expenses of the Lamm-Francq locomotives are lower, and hardly exceed that of horses.

So far the fireless locomotive has proved a complete success, and will undoubtedly supplant the horse on all our city railways. —*La Nature*.



THE LAMM-FRANCQ FIRELESS LOCOMOTIVE.

A FIRELESS LOCOMOTIVE AND RAILWAY TRAIN.

SWISS RAILROADS.

SWISS railroads, like many nearer home, have been having a hard time. That country has had an epidemic of construction, and as the ground is difficult and the population and production not heavy and not very progressive, the natural consequence has been unsatisfactory returns on the capital invested. The current market value of the securities of eighteen companies, representing about $215,000,000 of capital actually expended, is but $115,000,000. Their gross earnings in 1876 were at the rate of $8,250 per mile, which is much more than the average in this country (about $6,016 in gold).

THE ARMSTRONG DIVIDED MOUNTAIN GUN.

THE prospect of a campaign in Afghanistan gives interest to any question connected with mountain guns. It is probable, therefore, that the new Armstrong gun, made to divide asunder by unscrewing near the trunnions, so as to admit of its being carried on two mules, will receive the attention it deserves. Mountain equipments owe their efficiency to the occasional wars we have had to carry on in mountainous districts. Great campaigns may take place without there being much need for mountainous batteries, and so they are apt to drop out of view; but when the need comes it is pressing, for when mountains have had to be crossed much has depended on the means of transporting artillery over paths where wheels could by no means carry the guns. There are two cases to be considered—first, when a mountain range has to be traversed in order to reach an enemy in the plain beyond; and, secondly, in the case of fighting in the mountainous district itself. In the former it is desirable to carry *field* guns and their carriages by some means temporarily, and then place them in their normal service condition again, that is, on their wheels. In the latter the guns always require to be moved for a few yards on their wheels, for obviously they cannot be fired off the mule's back. They must be brought to a place, in short, that is sufficiently open to bring them into action. Such a place must frequently occur in any country, for if the wheels have brakes on them a moderately flat or even a rough piece of ground the size of an ordinary dining table will suffice for one gun, and even one gun may effect much. No artillery officer, however, would fail to find, in most cases, some means of bringing all his guns into action; but to point and fire them they would be placed on their carriages, even were it necessary to dispense with the wheels. This is the extreme case of mountain artillery action, for when we take the case of individual gunners firing rockets, without using machines, on rocks, where there is hardly standing room for a man, if we have not left the sphere of action of artillery practice proper, we have at all events carried it into a region where it has neither defined limit nor law. In the Abyssinian campaign, for example, on the homeward journey we are informed that the naval brigade made rocket practice at monkeys. Who can define the place where a sailor armed with a rocket may not follow a monkey? To keep then to the sphere of artillery in the sense of guns, we have on the one hand the case of action in mountain ground where the guns would seldom have the opportunity of traveling half a mile on wheels, so that they would only come off the mules' backs to go into action; and on the other, the simple conveyance of guns across a mountain barrier. In the former case we have to keep primarily in view the facility with which the guns can be taken off the mules and brought into action. In the latter, we have only a single packing and unpacking operation to consider, and the performance of which does not occur in the immediate presence of an enemy. Such a case, for example, as the transport of the French field artillery across the Alps by Napoleon, when each gun was made fast to long poles and carried by a number of men. Doubtless most of the cases occur between the extreme limits which we have indicated, but we do well to keep the two distinctly in view, seeing how severely an army would feel the want of artillery ready to hand in any continued course of fighting in the mountains, and on the other hand, how poorly equipped it would be for fair fighting in the plain if it had only the mountain batteries which we have hitherto had in use. The improvement which has taken place in late years in the actual material and construction of gun carriages and the means afforded by chambering or reducing the maximum strain of discharge on the gun have obviously rendered it possible to make a more powerful mountain gun than the feeble howitzer that has generally represented that arm. If, then, we compare the gun of ten years ago with any new gun that should now be constructed we should expect to find the latter firing a larger charge and imparting a higher velocity to its projectile, the carriage in all probability being strongly held by brakes and enabled by its superior quality to stand the requisite shock.

The new Armstrong gun, however, apart from any improvement of this kind, obtains an enormous advantage by simply unscrewing into two pieces, which are carried separately on mules, as shown in Figs. 4 and 5, next page. The breech portion weighs 201 lbs.; the muzzle portion, including the trunnion hoop, 200 lbs.—that is, 133 lbs. for the gun tube, and 45 lbs. for the hoop. Thus, while the entire gun weighs 401 lbs., the load on each mule is only the same as that of the last approved pattern of mountain gun, known as "Mark IV.," whose average weight is 201 lbs. The price we pay for this heavy gun, then, is the additional mule and the time necessary for joining together or taking apart the two portions of the gun. Supposing these operations to be reliable and easy of execution—which it is absolutely necessary should be the case, or we jeopardize the safety of our gun—we gain a field gun of fair average power in the place of a feeble howitzer of only the same caliber.

A high trajectory is, on the whole, a much less evil in mountain warfare than in the plain, for on rocky, broken ground, we gain so little from the effect of grazing, that but a very poor result generally accompanies the action of a shell exploding on the graze. Nor does a low trajectory give us the advantage of sweeping close to the ground when we fire over very broken slopes or across valleys. Nevertheless, the


FIG 2

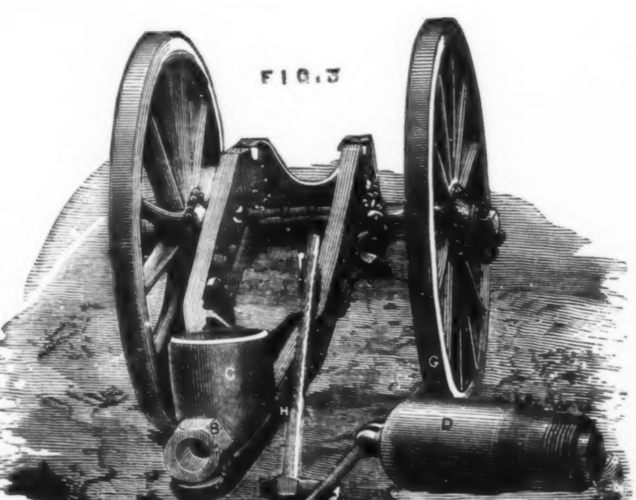


FIG.3

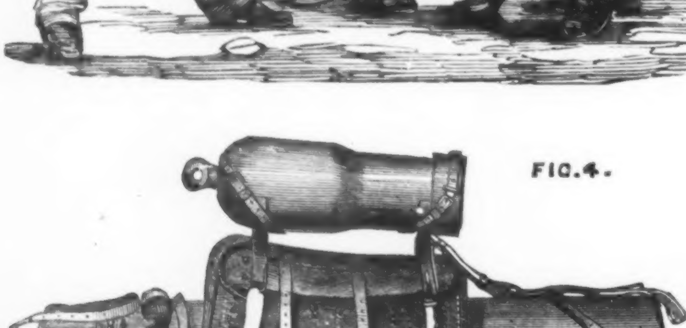


FIG.4.

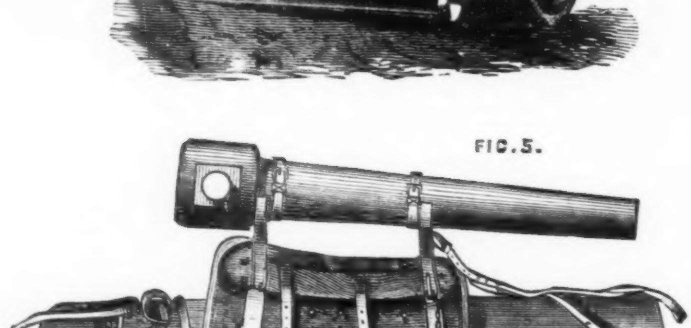


FIG.5.

THE ARMSTRONG DIVIDED MOUNTAIN GUN.

advantage of the powerful gun is still very great. Range is most important in many cases; accuracy, where the entire effect depends on the direct blow, still more so; it follows, then, that a battery of the Armstrong guns ought to be able to crush an ordinary mountain battery easily, often without much liability to injury itself; in support of which we may compare the power of the Armstrong seven-pounder with that of the service gun. With 2 degs. 10 minutes elevation the Armstrong gun at Madrid had an average range of 1,165 yards, and this was a gun weighing only 380 lbs., of less power than the pattern we refer to of 200 lbs. weight. The seven-pounder, of 200 lbs. weight, with this elevation, averages about 706 yards. With 5 deg 5 mins. elevation the Armstrong gun had a range of 2,187 yards against 1,466 yards of the service seven-pounder with the same elevation. That is to say, under these conditions the range of the lighter pattern of the Armstrong gun is about half as much again as that of the service mountain gun. Indeed, it compares favorably with the service 9-pounder of 8 cwt., whose ranges at the above elevations are about 1,187 yards and 2,114 yards. The initial velocity of the service 7-pounder is 968 ft., that of the Armstrong 200 lb. gun, 1,500 ft. per second. With regard to accuracy and effect, we have no data to give as to practice with shot or blind shell, but at Madrid the 7-pounder Armstrong, at a range of 1,095 yards, fired five rounds of shrapnel on a double row of targets making 483 hits—or 97 hits per round. At 2,190 yards it fired four rounds, making 261 hits - or 65 hits per round. We have no data at hand for recent shrapnel practice with field guns, and it is not fair to compare practice many years since with the above without making considerable allowance. At Dartmoor, in 1869, the best practice with the 9-pounder at 1,000 yards was 47 hits per round. The differences of circumstances are such that the practice cannot be easily compared. There were six rows of targets, but the range was not given; fifteen rounds were fired. Still the mention of these two cases is sufficient to show that the Armstrong 7-pounder, even of the lighter pattern, is greatly in advance of the 9-pounder gun of the service up to a recent date. We are not going too far, then, in saying that the Armstrong 7-pounder is an accurate and powerful field gun, and an arm of totally different quality to any hitherto brought into a mountain train. Its power in an extreme case of mountain fighting would be greatly felt, and the more open the country became, the more would its range, accuracy, and hard hitting tell. The original steel gun introduced in the Abyssinian equipment would have some advantage as to actual carriage. It weighed only 150 lbs., and its short length enabled it to be carried across a pack saddle, so that it was close in the hollow of the mule's back, and in case of any disturbance of equilibrium, would act with less leverage on him than the Armstrong gun, which is, in our opinion, perched too high, especially in the pattern shown in Figs. 4 and 5 herewith, but which has in the last pattern been bettered in this respect. The 150 lb. 7-pounder gun, however, fired a charge of only 6 ozs. of powder, and was superseded by the 200 lb. gun, firing a 12 oz. charge, and this latter is carried in the same way as the halves of the Armstrong gun, and being of the same height, has no advantage even as to carriage. The efficiency of the Armstrong gun for mountain service proper and all it promises, however, depend on the success of the screwing and unscrewing of the parts. We must, therefore, pass on to that most important matter.

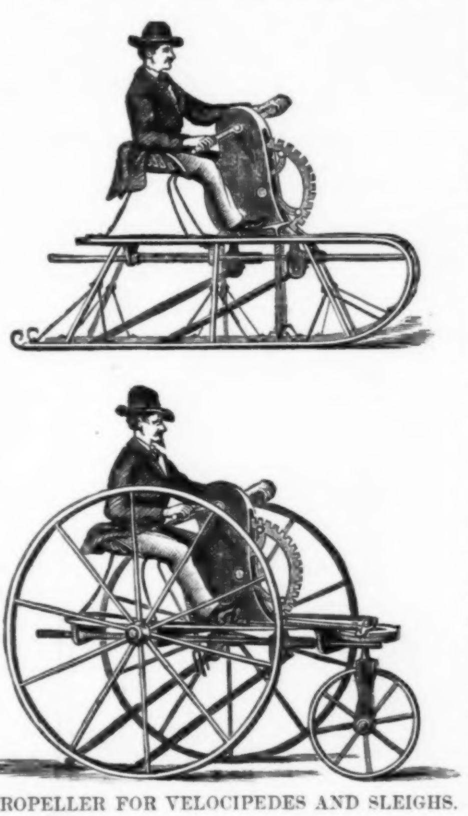
The nature of the operation will be seen by referring to Figs. 2 and 3. A block, C, is placed and held fixed on the trail of the gun; and D, the breech of the latter, is lowered into it, a bar, G G, through the cascable eye crossing the block and holding the gun from turning round. The muzzle end, including the trunnion hoop and trunnion, is now in a position to be unscrewed, which is effected in the manner shown; the man at A having fixed a stud, B, on the trunnion, so as to protect it, starts the screw by tapping with the hammer, H, as much as may be necessary. Fig. 3 exhibits the parts lying separate in the rear of the gun. Drilled men can take the gun to pieces and lay it on the ground in 25 seconds. They can put it together in about 35 or 40 seconds. Some officers may question whether some hitch might not occur in this in action. It is to be borne in mind, however, that it only has to be performed at those times when similar ones, such as dismounting the carriage and lifting the parts on to the mules, necessarily take place, against which the same objection may apply. We think ourselves that proof ought to be obtained that firing in no way fouls the screw or interferes seriously with the process. This proof can only be got by a trial which ought to have been made to a certain extent already, and which ought to be continued. The dimensions of the carriage, width of track of wheels, etc., correspond with the service mountain pattern, and a similar arrangement exists for a draught on flat ground, that is to say, shafts are supplied which can be attached to the trail of the gun, the balance of the piece on its carriage being such that it can be drawn in this manner when the ground admits of such locomotion. We do not, however, desire to enter into a discussion of parts in detail. This would only tend to obscure the leading feature to which we wish to call attention, namely, the division of a field gun into such parts as enables it to be carried on mules' backs. The idea of dividing the gun at this time was, we believe, suggested by Colonel Le Mesurier, R.A., though it has before now been thought of or carried out in historical times. The design of the gun we owe to Elswick, where the gun has been constructed and brought to its present condition. Coming, as it does, to meet a want which we fear may even now be a very pressing one, we cannot but hope that the gun is being supplied and sent out for earnest thorough trial in India, when it would be available for service.

In an Afghan campaign we might have instances when field guns might be opposed to us in a district to which we only have access by crossing mountains. An operation of this kind might be attended with success with the Armstrong gun we describe, under conditions such that, with the old pattern mountain gun, it might be madness to attempt it.—*The Engineer*.

PROPELLER FOR VELOCIPEDES AND SLEIGHS.

THE improved propeller we illustrate to-day is the invention of Mr. T. A. Zoebl, of Milwaukee, and is equally applicable to sleighs and ordinary velocipedes.

As will be seen from our engraving, the velocipede of Mr. Zoebl consists of two large wheels and a smaller steering wheel. The latter may be turned to the right or left, by means of two steering rods acting on a movable cross-piece, as the illustration shows, the rider pressing with the foot, on one or the other side, at the end of the rods. When not acted upon thus, the wheel is held in a position parallel with the large wheel by springs surrounding the steering rods. Thus the wheels cannot get out of their track very easily.



PROPELLER FOR VELOCIPEDES AND SLEIGHS.

The propulsion is effected by a system of toothed wheels, operated by hand by means of cranks, and acting upon two propelling rods, taking effect directly on the ground. They are forced back to the rear part of the vehicle by powerful springs, and alternately lifted up and pulled forward by the revolutions of the driving mechanism. By pressing on a knob provided alongside of the seat, the propelling rods are firmly pressed to the ground, thus acting as brake, by which the velocipede can soon be brought to a stop. When the pressure on the knob is released, springs provided for that purpose raise the propelling rods from the ground again.

To adapt this device to a sleigh, the steering apparatus must be changed correspondingly, as indicated in the drawing.—*Fortschritt der Zeit.*

AMERICAN SHIP CANAL.

A LONG-TALKED-OF ship canal to connect Chesapeake Bay with Delaware Bay, and shorten the water route from Baltimore to New York and Europe some 225 miles, seems likely now to become a reality. The estimated cost of the canal—17 miles long, 100 ft. wide, and 25 ft. deep—is $4,000,000; and the promoters claim that at the present commerce of Baltimore would give the canal an income of $800,000 from the authorized rate of toll, 20 cents a ton. The canal is to follow the valley of the Sassafras, and to be without locks. By means of it, vessels will be enabled to make three voyages between New York and Baltimore in the time now required for two, and the route will be much safer.

AUTOMATIC FURNACE FEEDER.

THE accompanying engraving illustrates an automatic feeder for boiler furnaces.

Fig. 1 is a front elevation, Fig. 2 a vertical section of the same.

The coal is contained in a box, *b* (Fig. 2), which must be filled up occasionally. From its bottom the coal falls into a cylinder in which revolves slowly a screw, *a*, carrying the coal toward the furnace. It arrives first on a plate that is situated under the stratum of coal already undergoing combustion. The air being excluded from this part, the coal at first is only converted into coke; the gases generated pass through the burning coal and are completely consumed. As the coal is fed in, the ashes are pushed forward and drop at *d*, into an ash-pit.

The screw is moved by pulleys and a shaft carrying an endless screw, as shown in Fig. 1. *e e* are doors closing air tight, to remove, when necessary, slags adhering to the grate.

In consequence of the constancy and completeness of combustion in this furnace the steam pressure in the boiler may also be easily kept constant. When the consumption of steam is changeable, the speed of the screw can be regulated so as to feed more or less coal, as required. The gases being completely consumed, there is no smoke, and a much greater amount of heat is obtained from the same quantity of coal, compared with other furnaces.

In ordinary furnaces, a large quantity of heat is lost by radiation, when the doors are open to receive a supply of coal. This is effectually avoided here. One man can attend to twice as many fires, when the automatic feeder is used, as usual. All sorts of short fuel may be used, such as sawdust, refuse bark from tanneries, etc.

The feeder is the invention of Mr. L. Schultz, of Meissen, Germany.

HOW TO MAKE A SUPERIOR GUM.

DR. G. THENIUS gives in the *Chemiker-Zeitung* the following formula: Pour upon 11 lbs. best potato starch a mixture of 7 ozs. pure nitric acid and 4 lbs. 6 ozs. soft water; stir well together and let stand for 24 hours at the temperature of about 80° Fahr., stirring from time to time. Then heat to 212° Fahr., add gradually from 4 lbs. 6 ozs. to 6½ lbs. more soft water, and boil till the mass begins to grow thick and transparent. To promote this there may be further added 1¾ ozs. pure nitric acid, diluted with 2 lbs. 3 ozs. of water. The boiling is continued till the liquid is clear, diluted with water if too thick, and strained through a woolen cloth. Next dissolve 11 lbs. gum arabic and 2 lbs. 3 ozs. of sugar in 8¾ to 11 lbs. of soft water, warming slowly, and adding a little more water if the whole is not perfectly dissolved. Strain carefully through a woolen cloth, and add to the filtered solution 1¾ ozs. nitric acid mixed with a little water. Heat to 212° Fahr. for an hour, adding gradually the first-mentioned solution of starch, and allow the whole to stand at this temperature till perfectly clear. If it is at all turbid, dissolve at a boil 8¾ ozs. isinglass in 6½ lbs. water and 2 lbs. 3 ozs. alcohol, keeping up the heat till all the spirit has escaped; strain through a woolen cloth, add ½ oz. pure nitric acid, heat once more, and add the solution gradually to the adhesive mixture. If any turbidity appears, filter again. The consistence can be regulated at pleasure by the addition of water.

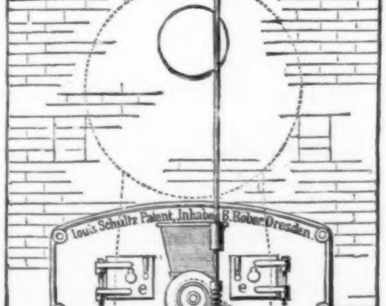


FIG. 1.

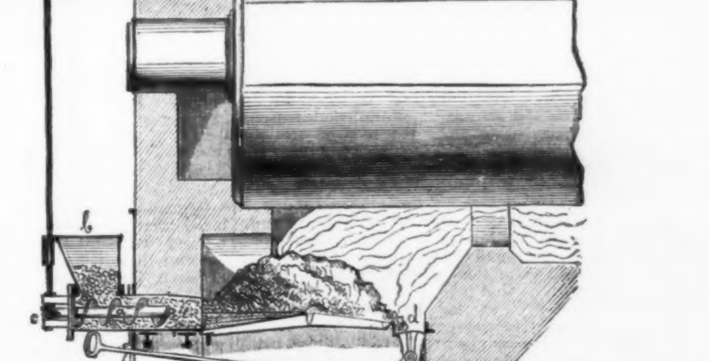


FIG. 2.

SCHULTZ'S AUTOMATIC FURNACE FEEDER.

[Continued from SUPPLEMENT Nos. 156, 157, and 158.]

ARTESIAN WELLS.

CHARACTER OF MATERIAL.

SPON says, in his "Practice of Sinking and Boring Wells": "Every permeable stratum may yield water, and its ability to do this, and the quantity it can yield, depend upon its position and extent." The type of permeable material is sand; of impermeable, compact clay. As rock is full of irregular fissures which do not exist in it in regular strata, there is small chance of obtaining water in it, and for this reason, as well as on account of the difficulty of boring in it, rock is avoided as much as possible. Between sand and clay there are innumerable grades of permeability according as the one or the other predominates or as other material, for instance gravel, is mixed with these. Experiments by Prestwich, quoted by Spon, have shown that ordinary silicious sand will hold about one third of its bulk of water, or from two to two and one half gallons per cubic foot. When clay and gravel are introduced the amount absorbed is less. When the material is compacted as in sandstone or limestone water is still absorbed, but in very diminished quantity. Drift material, consisting largely of sand and gravel brought down comparatively recently by rivers or floods, may yield water, but not in large supply. Alluvion, consisting of sand, gravel, rolled pebbles, clays, and found in the valleys of great rivers, is distributed more regularly than drift and over more surface, and hence may yield larger supply of water. But, as has been already many times hinted, it is in more regular, more widely extended, and, generally speaking, deeper strata of sandstones, limestones, and clays, that reliable supplies are to be sought. The striking of rock is, of course, no sign of failure. The rock may be drilled through, or if it is merely a bowlder, it may be avoided by another boring.

THE CLIMATE.

The amount of rainfall on the outcrop of water-bearing strata determines the quantity of water that may probably be obtained from them at a distance by artesian borings. An entirely rainless district may be supplied with artesian water. In fact the gentle tilting of alternating pervious and impermeable strata seems to be a special arrangement of nature, by which low, dry, unwatered plains may receive their share of irrigation. All that is needed is rain on the surrounding highland where the edges of the water-bearing strata are turned up and exposed. An examination into the condition of this outcrop (as in the last article), of its extent and of the rainfall upon it, may furnish data for roughly calculating the amount of water that the plains may expect to be able to obtain. For instance, on a steep outcrop less water can be absorbed than on a more level one; again, less water can be appropriated by the outcrop from a deluge immediately followed by burning sunshine, than from a long continued drizzle followed by dull cold days. It is unnecessary to enter further into this. The entire subject, in fact, is very simple, and even suggestions are hardly necessary to an intelligent and observant mind.

THE TOOLS.

Artesian well boring machinery has been made quite a study. A great number of inventions and improvements have been made over the primitive auger and rods, so great a number that it would be impossible in a short space even to name, much more so to describe and explain them.

A derrick is required, which may be easily rigged out of three spars. It must be at least as high as the length of the longest rods to be used in sinking the auger. A tackle is necessary for use with the derrick; also a barrel and cranks for winding the tackle rope. For boring in stiff clays, a twist auger of some kind is needed; for working in soft materials, a pod auger; for rock, a drill. The rods for sinking the auger may be made of stout poles, joined together by wrought iron couplings, and may be gotten up by any good carpenter and blacksmith. For obvious reasons it has been recommended to make the rods of straight grown trees of requisite diameter. Iron rods and pipes are used frequently, but while better than wood on many accounts, are much more expensive. Wooden rods may be turned by a stout wooden lever; but the iron rods and iron lever are better. The iron couplings for the rods are made with shoulders, upon which iron shoes attached to the hook on the tackle block catch, and by this means the rods are raised and lowered. Two of these shoes are needed. In the vast majority of cases the well must be tubed. Where any great lateral pressure is exerted by the strata passed through, it is necessary to use considerable force in the sinking of the tubes. They are best made of sheet iron, black or galvanized. Upon the lower pipe a steel ring sharpened on its lower edge is riveted, and serves to cut the way for the pipe. It must be stoutly riveted, for its detachment when at considerable depth may ruin the well. The pipe may be forced down by applying sufficient pressure at the top in almost any convenient way. Sometimes an iron ring is fitted over the top of the pipes. Chains attached to the ring descend, and are wound about a lever made of two stout timbers, spread so as to include the pipe. One end of the lever is fastened to the ground a foot or so from the pipe. The long end extends out for some twenty or thirty feet on the other side of the pipe, and is weighted. By this means tremendous pressure is exerted on the pipe. When sinking the pipe, sand or other fine material has to be removed from the bottom. This is accomplished by a sand pump. If the hole is not large enough to allow the pipe to pass, reamers are used to scour it out larger under the end of the pipe. With an outfit such as this, and in addition a few tools for recovering articles that may accidently fall down the well, arrangements for soldering the pipes and sharpening the cutting apparatus, any intelligent and careful man, with a couple of laborers, can sink an artesian well in favorable material and to a reasonable depth, say 200 or 300 feet.

COST OF OUTFIT.

The cost of the tools may be best determined by sending for the catalogue of some manufacturer. In a catalogue before us the prices are as follows:

Pod augers, varying in size from 4 inch to 11 inch, vary in price from $16 to $38. Cast steel twist augers, sizes 2, 2½, 3, etc., up to 6 inch, cost respectively $9, $11, $13, $14, $16, $18, $20, $22, and $24. A galvanized sand pump, 4½ inch in diameter, costs $19; 5½ inch, $21; 6½ inch, $23; 7½ inch, $27; 8½ inch, $33; 9½ inch, $37. The screw coupling, with straps for fastening them to wooden rods, cost $12 a pair; without straps, $6. Reamers cost $10 or $12; shoes, about $5; wrenches, $1.50; the block and straps for forcing the pipes, $11; an iron ring with chains as described above would cost more. Steel rings for the lower end of the pipe, as above, costs 75 cents per foot. Windlass and cranks, with barrel, $15. Lever for turning iron rods, $13; to turn square poles, $3; block and sheave, $5. Cast steel rock drills, of the following sizes, 2 inch, 2½, 3, 4, 5, 6, 7, 7½, and 8, cost respectively $8, $10, $12, $13, $15, $16, $20, $22, $23. This, says the *Mining and Scientific Press*, is the price list of only one house in San Francisco.

Artesian pipe is made in the following sizes:

Double black sheet iron: 6, 7, 8, and 11 inch, costing respectively 58 cents, 62 cents, 70 cents, and $1.22 per joint of two feet.

Galvanized, single, with collars: 6, 7, 8, 11, 12, and 13 inches; cost, $1.28, $1.57, $1.60, $2.50, $3.15, and $3.45 per joint of two feet.

From these price lists the cost of the outfit for a well of given diameter and depth can be approximately calculated.

A complete outfit of tools for boring wells of any of the ordinary sizes can be obtained for from $400 to $600. It will certainly pay farmers to club together, buy complete apparatus, and use it by turns.

A Philadelphia house is introducing well boring apparatus on this coast. It is interesting to look over their catalogue.

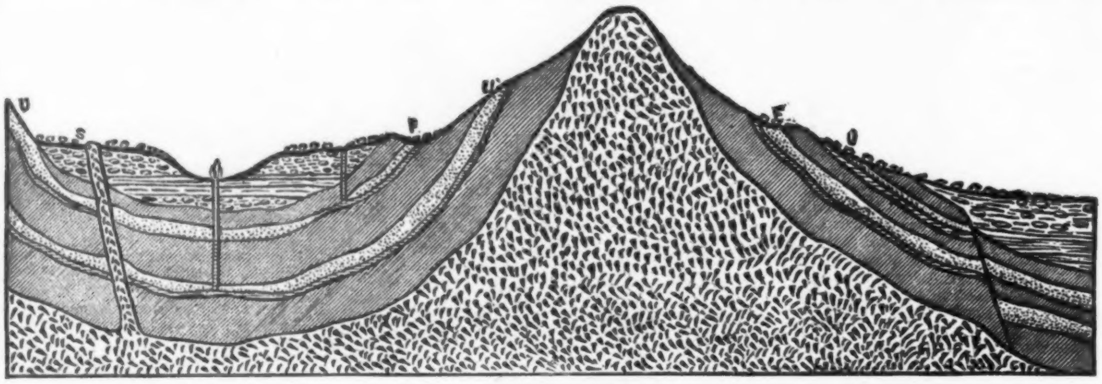
In the catalogue referred to, under the head of "boring rig for earth, soft rock, and loose stones," the following articles are mentioned:

One auger (any size under 20 inches); six couplings, enough for 70 foot well, with improved safety pins; one set of derrick trimmings; one pair boring wrenches, 6 feet long, with 1¼ inch gas pipe handles, made light and strong, to turn the auger by hand power; 70 feet 1⅜ inch square iron shafting, with couplings fitted and attached; four wood fenders or wheels to attach to each bar of shafting to keep the auger perpendicular and in the center of the well; one 7 inch wood drum; reamers, 38 or 40 inches. All this costs $141. There are various extras catalogued; also, a complete machine for boring to greater depths.

We are indebted for information to Ellis & Lennon, 53 Beale street, Francis Smith & Co., 130 Beale street, San Francisco, and to Charles D. Pierce, 4206 Elm avenue, Philadelphia, Pa.

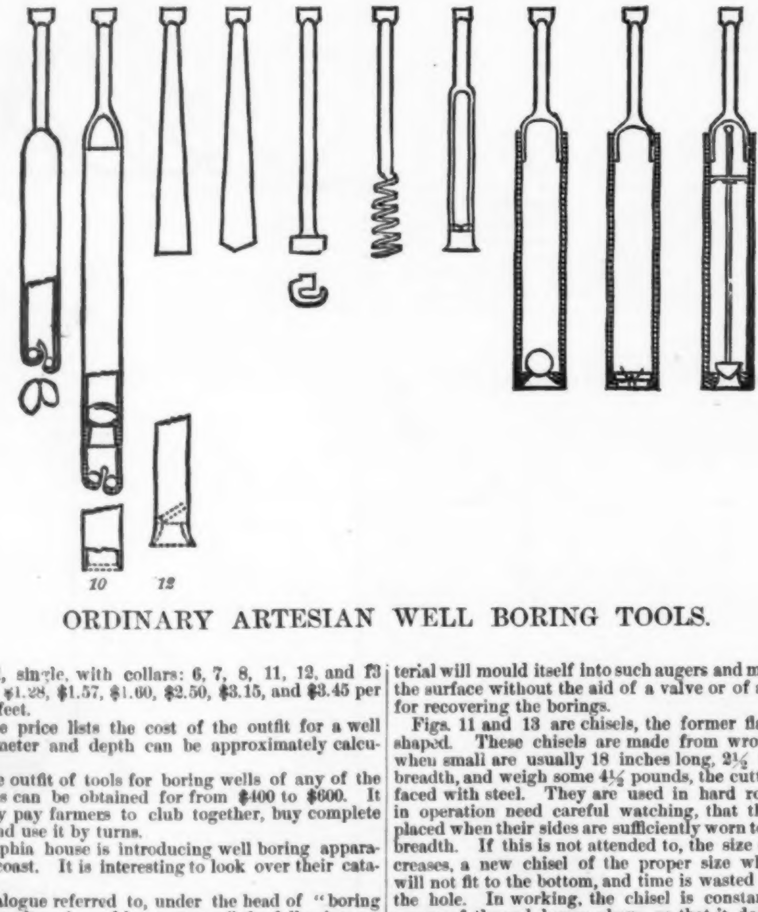
DESCRIPTION OF TOOLS

The tools mentioned in the last article are comparatively modern. Well boring, as it was introduced into Europe, perhaps from China, was accomplished by means of a drill attached to the end of a rope for making the hole, and buckets or shell pumps for removing the debris. This method is seldom used now, the ropes being superseded by rods, and the drills, where possible, by augers.



ARTESIAN WELLS—WATER-BEARING STRATA—SHOWING FAVORABLE AND UNFAVORABLE OUTCROP.

Figs. 8 to 19 will convey some idea of the construction and mode of operation of some of the tools used. They, as well as the following descriptions, are mostly taken from Spon's "Practice of Sinking and Boring Wells." Fig. 8 is the common earth auger, three feet long, the lower two thirds being cylindrical. The bottom is partially closed by the lips, and there is an opening a little way up one side for the admission of soft or bruised material. Augers are only used for soft rock, clay, and sand, and their shape is varied to suit the nature of the strata met with, being open and cylindrical for clays having a certain degree of cohesion, conical, and sometimes closed, in quicksands. Augers are sometimes made as long as 10 feet. The shell is made from 3 to 3½ feet long, of nearly the same shape as the common auger, sometimes closed to the bottom, Figs. 10 and 12, when they are sand pumps rather than augers, or with a nose, Fig. 9; in either case there is a clack or valve inside to retain borings of a soft nature, or prevent them from being washed out in a wet hole. The augers are frequently if not generally semi-cylindrical only. Stiff, putty like material will mould itself into such augers and may be drawn to the surface without the aid of a valve or of any special tool for recovering the borings.



ORDINARY ARTESIAN WELL BORING TOOLS.

Figs. 11 and 13 are chisels, the former flat, the latter V shaped. These chisels are made from wrought iron, and when small are usually 18 inches long, 2½ inches extreme breadth, and weigh some 4½ pounds, the cutting edge being faced with steel. They are used in hard rocks, and while in operation need careful watching, that they may be replaced when their sides are sufficiently worn to diminish their breadth. If this is not attended to, the size of the hole decreases, a new chisel of the proper size when introduced will not fit to the bottom, and time is wasted in reaming out the hole. In working, the chisel is constantly turned by means of the rod levers above, so that it does not fall consecutively in the same position. The bore is thus kept circular. Every time a fresh chisel is lowered to the bottom it should be worked round in the hole, to test whether it is in its proper size and shape; if this is not the case, the chisel should be raised at once and worked gradually and carefully until the hole is as it should be.

In some material a chisel may be worn and blunt before cutting three-quarters of an inch; it must, therefore, be raised to the surface and examined frequently. In other material the wear may not be so great.

For tempering boring chisels, Spon gives the following sets of directions:

1. Heat the chisel to a blood red heat, and then hammer it until nearly cold; again heat it to a blood red, and quench as quickly as possible in 3 gallons of water in which is dissolved 2 ounces of oil of vitriol, 2 ounces of soda, and one-half ounce of saltpeter, or 2 ounces of sal ammoniac, 2 ounces of spirit of niter, 1 ounce of oil of vitriol, the chisel to remain in the liquor until it is cold.

2. To 3 gallons of water add 3 ounces of spirits of niter, 3 ounces of spirits of hartshorn, 3 ounces of white vitriol, 3 ounces sal ammoniac, 3 ounces alum, 6 ounces of salt, with a double handful of hoof parings, the chisel to be heated to a dark cherry red.

Drills are used of other shapes than those in the figures. The cutting edge of some is shaped like a T; of others, like a Z; of still others, like an S.

Figs. 14, 15, and 16 present some of the least complex "accidental tools."

Fig. 14 is a "crow's foot." It is used when the boring rods have broken in the bore hole for the purpose of extracting that portion remaining in the hole. It is of the same length, and, at the foot, of the same breadth, as the chisels. When the rods have broken, the part above the fracture is drawn out of the bore hole and the crow's foot screwed on in place of the broken piece; when this is lowered down upon the broken rod, by carefully twisting the toe is caused to grip the broken piece with sufficient force to allow the portion below the fracture to be drawn up. A rough expedient is to fasten a metal ring to a rope and lower it over the broken rod, when the rod cants the ring, and thus gives it considerable grip.

Fig. 15 is used for the same purpose. A double worm or wad hook may also be used. The latter is also useful in withdrawing stones.

Fig. 16 is a bell box, for drawing broken rods or tools accidentally loosened and dropped. When this tool is lowered on top of the broken rod, the end of the latter pushes up between the two valves or palls, shown in the figure. As soon as the bell box starts to return, the weight pulls the palls closely against the broken rod, which, thus firmly gripped, may be drawn up.

Of these withdrawing tools, the crow's foot is recommended as the best, requiring less intelligent supervision than the others.

Figs. 17, 18, and 19 represent tools used for removing debris. Their operation is simple. When the tool is dropped, the borings, sand, clay, small stones, or whatever, force up the ball, flap valves, or cone, as the case may be (see Figs.), and enter the shell of the tool. But, having once entered, they cannot return, their own weight helping to keep down the valves. Thus confined, the borings are drawn to the surface.

ARTESIAN WELL TIDES.

Some time since the Charleston (S. C.) *News* announced that a close observer had noticed that the Citadel Green artesian well in that city was affected by the tides, the flow being more copious at high than at low tide. A similar state of things has since been demonstrated in a well at West Point Mills. The water bearing stratum was tapped at a depth of 425 feet, and a moderate stream of ten to twelve gallons a minute flows at the surface. To ascertain the height to which the water would flow, a section of tubing, six feet in height, was erected over the well, and it was noticed that at intervals the water would flow over the pipe. Another section was then screwed on, and a float, to which was attached a rod or marker, was inserted at the mouth of the tube, and this float rose and fell with the water in the tube, its movements being indicated by the feet and inches on the marker. The experiment was continued for several tides in succession, and it was shown that the highest point above the surface reached by the water was 8 feet 3 inches, and the lowest, 5 feet 3 inches, and these extremes were reached at the regular interval of time between high and low water at the wharf, only a few yards distant, though not at the same instant of time, the artesian tide being nearly an hour ahead of the tide at the wharf, which would make it correspond with the tide on the bar.

Experiments with wells more or less distant from tide water would now seem to be in order, to determine how far from the coast, and under what conditions, such tides in artesian wells are possible.

ACTION OF SOME REAGENTS ON VEGETABLE FIBERS.

Flax fibers are nearly entirely dissolved by cold, concentrated sulphuric acid. Placed in a solution of ammoniated copper, the fibers swell up and the interior membrane is dissolved. Caustic potassa dyes the fibers orange yellow. Hemp is dyed green by sulphuric acid. The fibers swell in a solution of ammoniated copper and are partially dissolved, while the interior membrane remains unaltered. Caustic potassa dyes the fibers orange yellow. Jute, treated with a solution of chromic acid containing a small quantity of sulphuric acid, is turned blue. In a solution of ammoniated copper the jute fiber swells up and it acquires an intensely yellow color by immersion in a solution of sulphate of aniline. The fiber, of Phormium tenax, or New Zealand flax, the raw fibre is burnt by smoking nitric acid, but this does not apply to bleached or cured fibers. The fibers swell up in a solution of ammoniated copper. Sulphate of aniline dyes it pale yellow. Linen is colored by tincture of madder orange, and red by aniline (magenta) and subsequent immersion into ammonia. Chloride of tin dyes it black, and caustic sodium yellow. Iodide of potassium imparts to it a bluish tint. Soaked in oil or glycerine and pressed, the flax fiber becomes translucent. Crude hemp fibers, when treated with hydrochloric acid, become hard and decomposed. Ammonia colors them green and afterwards yellow. The cured fiber is colored violet. The fiber of Phormium tenax is colored violet by chlorine water and ammonia.—*Pol. Revue.*

Detection of Free Tartaric Acid in Wine.—Professor Claus evaporates to a sirup and agitates with ether. If free tartaric acid is present the ether leaves on evaporation a crystalline deposit, which, if dissolved in water, gives, on the addition of an alcoholic solution of potassic acetate, a precipitate of tartar. The author proves the solubility of tartaric acid in ether, which is denied in most textbooks.—*Polyt. Notizblatt.*

[Concluded from Supplements 157 and 158.]

GALVANIC BATTERIES.

No. III.

By Geo. M. Hopkins.

Grove's Battery.—In this battery the sulphate of copper solution used in the Daniell is replaced by nitric acid, and the copper by platinum, by which greater electro-motive force is obtained. Fig. 27 represents one form of this battery. The glass vessel, A, is partly filled with dilute sulphuric acid (1 part of acid to about 10 or 12 parts of water).

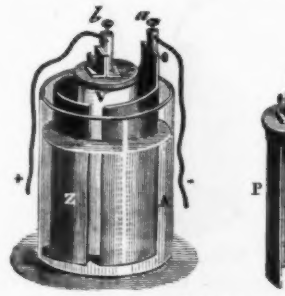


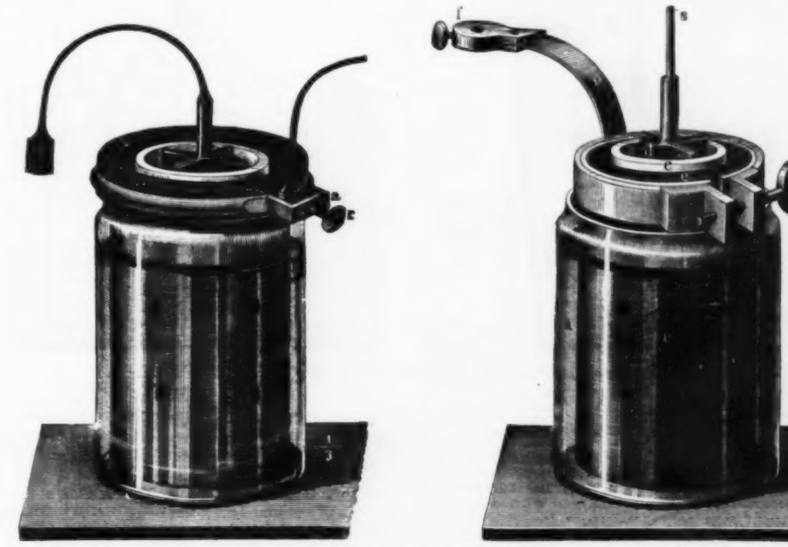
Fig. 27.—GROVE.

In this vessel is placed a zinc cylinder, Z, open at both ends and slit down one side, and in the cylinder, Z, is placed the porous cell containing ordinary nitric acid. A plate, P, of platinum, which is bent in the form of an S, is fixed to the cover, *c*, which rests on the porous cell and is immersed in the nitric acid. The platinum is connected with the binding screw, *b*, and there is a similar binding screw on the zinc.

The outer vessel is about 5 inches in diameter and 7 inches high.

In this battery the zinc should be carefully amalgamated.

Bunsen's Battery, as improved by Stöhrer, is shown in Fig. 28. In the glass jar is placed a cylinder of very compact carbon, which has on the top a projecting edge that rests upon the edge of the glass vessel and is surrounded by a heavy copper ring, having an offset portion, *a*, in which there is a bending screw, *r*, for clamping the platina faced copper strip, *p*, against the surface of the carbon, which is flattened to insure a good contact. The upper portion, or projecting edge, of the carbon should be soaked in melted wax, and the copper ring should be protected with a coating of wax and rosin. Within the carbon cylinder is placed a porous cup which contains the zinc; the latter is cross-shaped in section, and should be amalgamated. The porous cup is filled with dilute sulphuric acid, and the glass jar is filled with concentrated nitric acid. The zinc of one element is connected with the carbon of the next. The zinc of the last element forms the — pole, and the carbon of the first forms the + pole. When the wire is closed the positive current flows from carbon to zinc.



Figs. 28 and 29.—BUNSEN.

The Siemens-Halske zinc-carbon element is shown in Fig. 29. The carbon cylinder, *c*, is 4½ inches high, 2 1-6 inches inside and 3 inches outside diameter; the porous clay cup, *e*, is 4½ inches high and 2 inches outside diameter. The zinc *d*, is cross shaped, and the wire, *s*, is soldered to it, which is connected with the carbon of the next element by means of the clamp screw, *f*. There is a leaden ring around the upper part of the carbon, which is embraced by a copper band which may be drawn together by a tangent screw.

The solution for both porous cell and glass jar consists of sulphuric acid 1 part, water 15 or 20 parts. The zinc should be carefully amalgamated.

The Chromic Acid Battery, shown in Fig. 30, is a modification of the Bunsen battery. In this battery, which is similar to the Grove in form, a zinc cylinder surrounds the porous cup, and a rod of carbon replaces the platinum foil in the Grove. The zinc is amalgamated and the jar is filled with saturated solution of common salt, or with sulphuric acid diluted with 20 parts of water.

The porous cell is filled with a solution made by dissolving one pound of bichromate of potash in ten pounds of hot water, and when cold, adding five pounds of strong sulphuric acid.

This is an inexpensive and convenient form of carbon battery.

Easily Made Bichromate Batteries.—Figs. 31 and 32 represent in section easily constructed carbon and bichromate batteries.

The element shown in Fig. 31 consists of a small jar or tumbler, A, in which is placed a piece, B, of sheet zinc bent up into a cylindrical form, but not joined at the edges. Within the zinc cylinder is placed an ordinary tobacco pipe bowl, C, of large size, having a base, D, formed of plaster of Paris. In the pipe bowl there is a carbon pencil, E, which may be procured from any dealer in electrical apparatus. A wire is inserted with a twisting motion, into a hole drilled in the top of the carbon pencil.

A saturated aqueous solution of common salt is placed in the tumbler, A, and in the pipe bowl (which in this case forms the porous cell) is placed a solution made by dissolving 3½ ozs. of bichromate of potash in 1 quart of hot water, and when cold adding slowly 1 pound of sulphuric acid.*

Fig. 32 represents a battery which is similar to the one just described, but it may be made on a larger scale. In a jar, F, 5 inches high and 5 inches in diameter, is placed the zinc, G, which is a little shorter and a little smaller in diameter than the jar. An ordinary unglazed flower pot, H, 4 inches high, is placed within the zinc, and in it is placed a piece, I, of carbon, taken from a gas retort and cut roughly into shape, so that it nearly fills the pot. A piece of copper wire is wound around the upper end of the carbon. The flower pot, which in this case is the porous cell, contains the bichromate solution, and the jar, F, outside of the flower pot, is filled with a saturated solution of common salt.

In the Fuller Battery, Fig. 33, the zincs, so long as they last, are permanently amalgamated. In the accompanying figure two cells are shown. The carbon plate is placed in the outer vessel in a solution of the bichromate of potash. Three ounces of the crystals of this salt are placed in each cell, in a solution consisting of nine parts of water to one of sulphuric acid. The zinc element, which is of the shape shown in the figure, is placed in a porous tube, to which an ounce of mercury is added, and which is then filled up with water only. The addition of this mercury is the essential feature of the battery, and to it the disappearance of the main objections which were previously to be urged against the old bichromate form is chiefly due. The zinc plate is in this way kept permanently amalgamated so long as it lasts; the consequence is that not only is the internal resistance of the battery largely diminished, but its constancy—the *sine qua non* of any galvanic combination for telegraphic purposes—is to a great extent insured. The action, after the battery is charged and the elements are connected with each other, commences almost immediately, and reaches a maximum in the course of a few hours.

The maintenance is a very simple matter. On an ordinary working circuit, such, for instance, as a single needle or moderately busy printer, no extra crystals will be required, after the battery is once set up, for a period of six months. So long as the solution remains of an orange color, none, it is stated, will be required; only when it begins to assume a blue tint need crystals be added to it. The only specific fault which developed itself in the battery during an experience of over eighteen months was the eating through of the rod of the zinc element, under the influence of the acid employed. This danger has been effectually got rid of by covering the rod with some protective covering—wax,

Fig. 30.—CHROMIC ACID OR CARBON.

India rubber, or the like. An objection urged against the battery was that even when the cell was not in action, the zinc seemed to be acted upon and gradually to disappear. Such may doubtless be the case, for the mercury has the power of effecting this; but from the resulting amalgam which is thus formed it will be found that an electro-motive force will be produced as powerful as that in the original combination; and the strength of current will be in no way diminished so long as a good connection is insured between

* This mixture should be carefully handled, as it is destructive to almost everything with which it comes into contact.

this amalgam and that portion of the metallic zinc which remains.

The electro-motive force of the combination is equal to about two volts, or twice that of the Daniell's cell; the internal resistance, by varying the thickness of the porous vessel and the strength of the solution, may be made to vary from half an ohm up to four ohms, according to the work which the battery is called upon to perform.

Marié Davy's Quicksilver Battery.—Fig. 34 is very successfully used in France at the present time. It is a zinc-carbon element, in which the zinc stands in pure water, and the carbon in a paste of moistened proto-sulphate of mercury in a porous cup. The reduction in the inside of the element follows the same course as the Daniell; the zinc becomes oxidized through the oxygen of the decomposed water, and the hydrogen which is set free reduces the oxide of mercury which proceeds from the decomposition of the sulphate. Metallic mercury forms on the bottom of the porous cell.

According to a French authority 38 elements were in uninterrupted activity for six months without requiring any cleaning or renewing whatever, the current being equal to 60 Daniell elements, while the dimensions were smaller than the Daniell, which, under the same conditions, lasted only three months.

The glass vessels were 3½ inches high, 3 inches diameter; the zinc surface was 2⅛×2¼ ins., and the porous cups were 2¾×1¾ inches. The construction of this battery is the same as that of the carbon battery shown in Fig. 30.

Fig. 35 shows a small Marié Davy battery, such as is used with electro-medical apparatus. The battery represented consists of two elements placed in a small vulcanite vessel having a median partition. In the bottom of each compartment is placed a small plate of carbon. A wire runs from one of these carbons through the outer wall of the vessel, and a wire runs from the other carbon through the median partition and forms one of the supports of one of the zincs, the other edge being supported by a ledge in the vulcanite vessel.

The other zinc is supported on one side by a wire that extends through the wall of the vessel.

A A, conducting cords; C, suspension rod and set screw combined, to connect between second and third cells in series; *a a*, poles of battery; *b b*, two set screws to couple for quantity; *d*, an extra binding post, not essential, but convenient when two cells only of the battery are required; *e e*, air tubes.

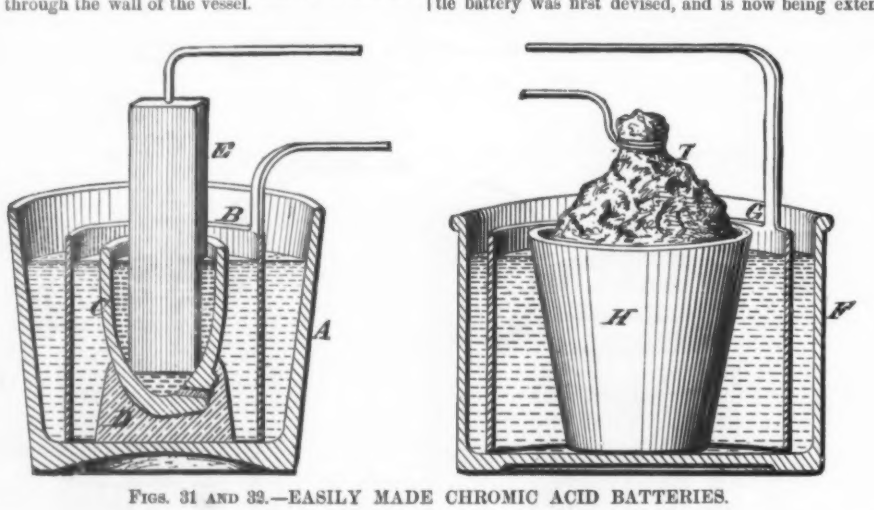
The composition of the fluid is one measure of commercial sulphuric acid to five of water, and to each pint of such dilution two ounces of bichromate of potash, though chromate of calcium, if substituted for the potash salt, will give a much higher electro-motive force, and, consequently, a much greater thermal power.

FIG. 34.—MARIE DAVY QUICKSILVER.

In order to guard against splashing, the quantity of fluid put into each cell should not exceed seven and a half fluid ounces, but, when the zincs become thin from use, eight ounces may be accommodated.

To connect the battery for intensity, turn down C firmly and raise *b b*; and for quantity, reverse the operation by turning down *b b* firmly and releasing C from its contact with the lower metallic connection.

In galvano-cautery, the main purpose for which this little battery was first devised, and is now being extensively used, and more particularly during certain difficult and complicated surgical operations, this simple means of changing the entire character of the current to meet emergencies is of the utmost importance.



FIGS. 31 AND 32.—EASILY MADE CHROMIC ACID BATTERIES.

The poles are pressed by springs which are secured to the bottom of the box in which the battery is carried, and attached to the wires of the coil or other apparatus in connection with which the battery is used.

The zincs are about 2 inches square, the carbons are somewhat smaller. The battery is charged with a solution of proto-sulphate of mercury.

In the Byrne Battery, Fig. 36, each negative element consists of a plate of copper, to one surface of which, as well as to its edges, a sheet of platinum foil, compact and free from pin holes, is soldered, and to the opposite surface or back a sheet of lead, the three metals being so united that the copper shall be effectually protected from the action of acids. The lead back and edges are then coated with asphaltum varnish, acid-proof cement, or any other like substance; and, lastly, the platinum face, being first rubbed over gently with emery paper, is to be thoroughly platinized in the usual manner.

Each cell of the battery above described contains two such plates, between which a single zinc is suspended, and when the elements are immersed so that the exciting fluid reaches within an inch of the top, a negative surface of 20 square inches is brought into action. It will thus be seen that the platinum alone is the negative metal, and the copper core a conducting body merely, while the lead, being almost passive, serves no other purpose than to protect the copper, so that any other, and, best of all, a non-metallic substance capable of resisting the action of bichromate solutions, might, with advantage, be substituted for the lead.

To keep the metallic surfaces constantly clear the exciting fluid in this battery is agitated. This is accomplished by means of an elastic air forcing bulb which is connected with a series of air pipes extending into the fluid.

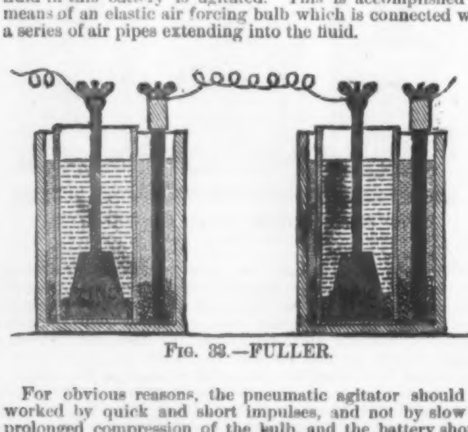


FIG. 33.—FULLER.

For obvious reasons, the pneumatic agitator should be worked by quick and short impulses, and not by slow or prolonged compression of the bulb, and the battery should not be kept immersed except when in action.

Grove's Gas Battery.—Fig. 37. A C is a glass tube with a series of tubular legs attached to and opening into it; it terminates at A in an opening closed by a glass stopper, and at C in a funnel-shaped opening. Into each of a series of glasses, B, two platinum plates are fixed, one long and narrow, the other shorter and wider, the former being placed lower than the latter; the wide plate of one cell is connected

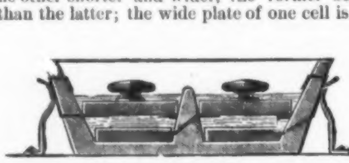


FIG. 35.—MARIE DAVY QUICKSILVER (small).

with the narrow one of the next by means of platinum wire. The glasses are then filled up to the top of the narrow plates with acidulated water, and in the vessel, Z, filled with dilute sulphuric acid is placed a piece of zinc, supported on a little tripod. The stopper being removed from the tube, A C, the legs are immersed in the cells so that each narrow platinum plate may be inclosed in a leg, the wide one being excluded and half exposed to the air. The hydrogen evolved in the vessel, Z, will rise and fill A C, expelling the air.

The glass stopper is then to be inserted into A, and the generation of hydrogen will continue until the piece of zinc becomes uncovered with acid; then the narrow strips of platinum will be exposed to an atmosphere of hydrogen in the legs of the tube, the wide ones being exposed to the oxygen of the air. A current of electricity will thus be generated; the electrode connected with the terminal narrow plate being negative, and that connected with the terminal wide plate positive. This battery is of little practical use, except for experimental purposes.

SECONDARY BATTERIES OF M. PLANTE.

Secondary currents, or currents of polarization, have formed the subject of numerous researches ever since the period when they were discovered.

The Voltameter is an instrument in which water is decomposed by the current from an ordinary galvanic battery. At the exact instant when the Voltameter has been just subjected to the action of the battery, it may be regarded as a secondary couple or element; if the two electrodes are now connected with the wire of a galvanometer the needle of the latter will be deflected during several seconds, and will show the passage of a current which grows gradually weaker and becomes imperceptible after a somewhat short space of time. This current is what is called a secondary current; it has been supplied by the battery to the Voltameter, and it is given back again by the latter.

M. Planté showed, as early as 1859, that lead is the most suitable metal for employment in secondary batteries; and he has, since that time, still further confirmed the superiority of this metal. Fig. 38 shows a secondary element as now con-

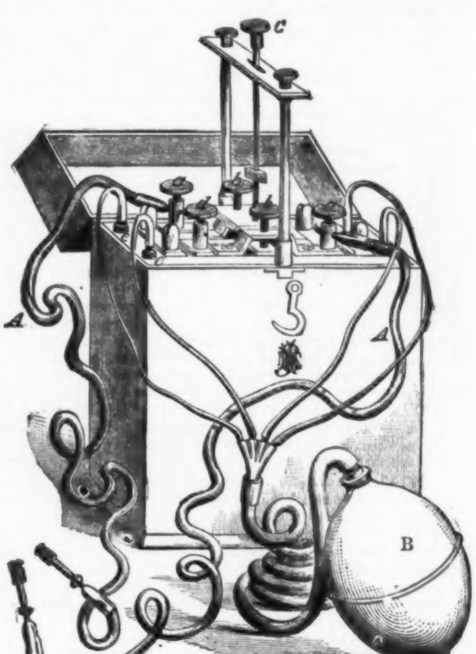


FIG. 36.—BYRNE.

structed. In a tall vessel of glass, gutta-percha, or ebonite, are placed two sheets of lead, rolled spirally, and parallel one to the other, and kept from touching by two cords of India rubber rolled up with them; these two sheets of lead are immersed in a solution of one part of sulphuric acid to nine parts of water. The vessel is closed by a sealed cover pierced with a small hole, through which the liquid can be poured in or extracted, and which also allows the escape of any gas which may be generated during the charging of the battery. The apparatus is surmounted by a disk of ebonite, upon which are fixed two contact pieces in connection with the two electrodes; two clips are also provided for the purpose of holding metallic wires to be made red hot or melted by the secondary current.

Two Bunsen cells, or, in their stead, three Daniell cells, are required to charge this secondary element. During the operation of charging one of the electrodes oxidizes, a brown coating of peroxide of lead soon shows itself, and the metallic appearance disappears entirely; the other electrode also changes in appearance, its surface becomes covered with a powdery gray coating.

When the charge has attained its maximum—that is to say, when oxygen commences to be given off by the brown electrode, it is well to disconnect the secondary element from the charging battery, for any further expenditure of the polarizing current is entirely wasted.

The secondary element once charged in this manner and left to itself will retain a portion of its charge for several days; and even at the end of a week it is still far from being exhausted.

The secondary element, when fully charged, has an electro-motive force equal to one and a half times that of a Bunsen; it will redden a platinum wire of a greater or lesser diameter according to its size, or rather according to the size of the electrodes; for it is of course understood that the quantity of electricity which the apparatus can furnish is in proportion to the extent of the surface subjected to the action of the polarizing current and covered with an active electro-chemical deposit.

The spiral form of the electrodes gives an element having a large surface and a small resistance within a small space, so that one of Planté's secondary elements is equal to an active or ordinary element of a very unusual size; the small pattern has an active surface of 124 square inches, the large pattern of a surface of 620 square inches.

The current furnished by the secondary element will effect chemical decomposition, act upon an electro-magnet, etc.

A secondary element is all the better for having been charged and discharged a great number of times; at first, when it is almost new, there is an advantage in polarizing the electrodes, sometimes in one direction and sometimes in the other, reversing several times the direction of the charge; but when the element is formed the greatest care must, on the contrary, be taken to charge it always in the same direction.

These secondary elements can be joined together, either for intensity or for quantity, and they form batteries capa-

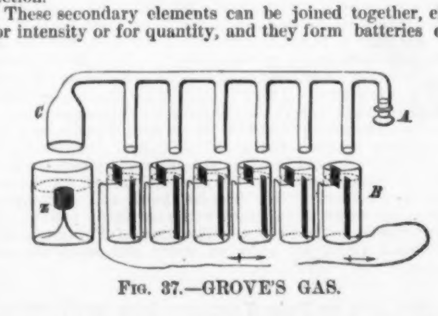
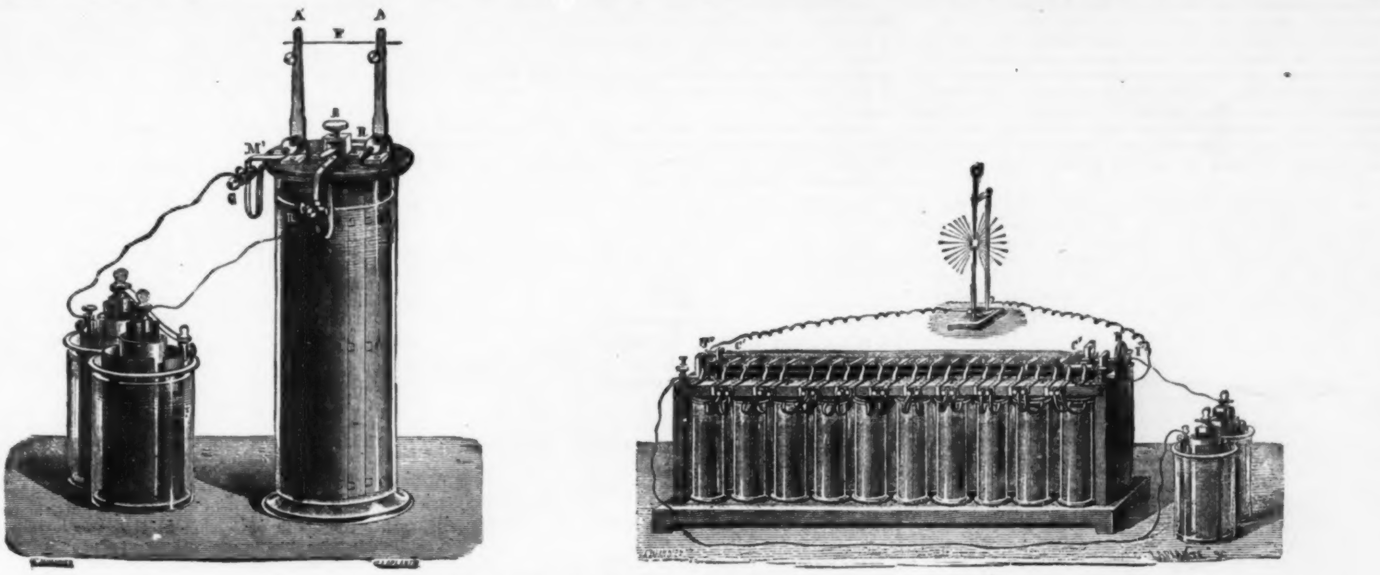


FIG. 37.—GROVE'S GAS.

ble of producing all the effects of batteries of the ordinary form, and of the most powerful kind. Fig. 39 represents a secondary battery as arranged by M. Planté, and such as would render the most valuable service in a variety of applications.

It is easily perceived that the secondary battery can only

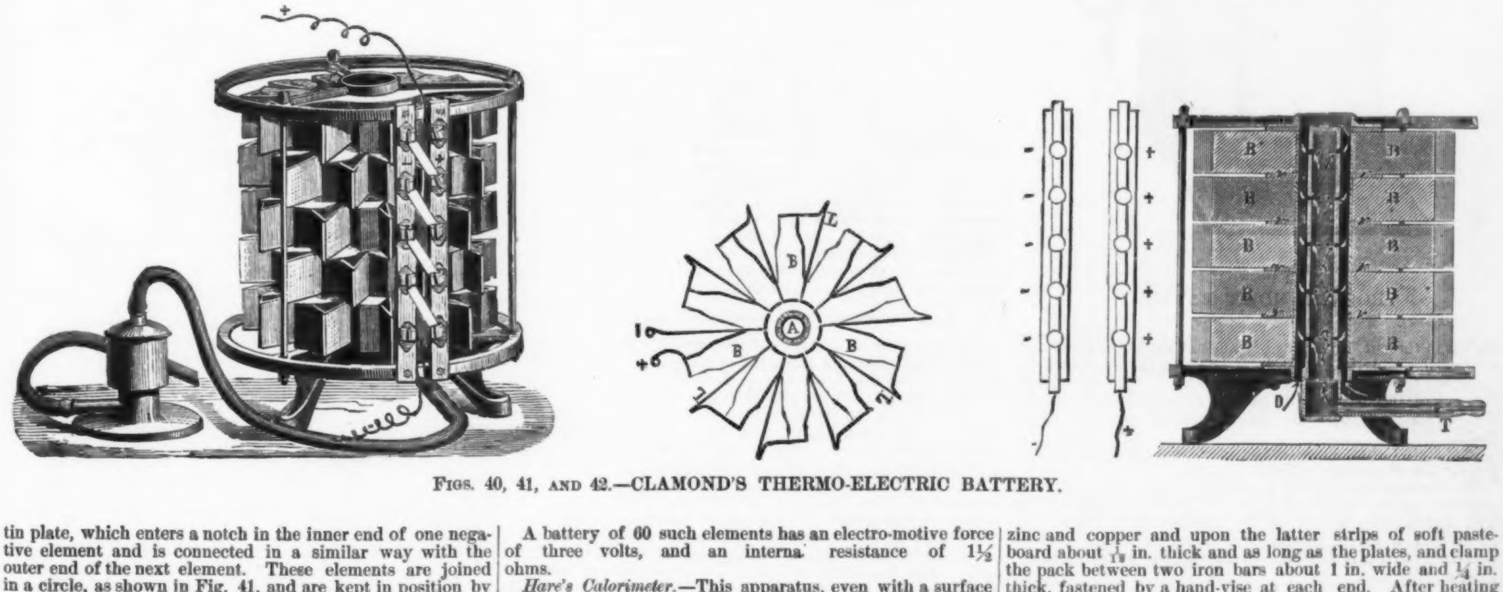


FIGS. 38 AND 39.—PLANTE'S SECONDARY.

produce effects of short duration, but in a very great number of cases such effects are all that is required.

Clamond's Thermo-Electric Battery, which is shown in perspective in Fig. 40, in plan in Fig. 41, and in vertical section in Fig. 42, has been used for telegraphic purposes and for electroplating. In this battery the negative element consists of an alloy of two parts of antimony and one of zinc, cast in a flat spindle-shaped bar, B, from 2 to 3 inches in length, by ⅜ in. in thickness. The positive metal is a thin strip, L, of tin plate, which enters a notch in the inner end of one negative element and is connected in a similar way with the outer end of the next element. These elements are joined in a circle, as shown in Fig. 41, and are kept in position by a paste of asbestos and soluble glass. Flat rings, V, of this composition are also made and placed between the series of elements, which are piled one over the other, as shown in Figs. 40 and 42. The connection between the several series is made by soldering together positive terminals of one series with the negative of the next, as shown in Fig. 40. When the battery is complete the interior presents the appearance of a perfect cylinder.

The heating is effected by means of coal gas, admitted through an earthenware tube, A, perforated with numerous small holes. The temperature should not exceed about 200°.



FIGS. 40, 41, AND 42.—CLAMOND'S THERMO-ELECTRIC BATTERY.

A battery of 60 such elements has an electro-motive force of three volts, and an internal resistance of 1½ ohms.

Hare's Calorimeter.—This apparatus, even with a surface of only 1 or 2 square feet, gives a very powerful current for a short time. Its comparative cheapness and convenience are great recommendations. It need only be placed in the tub to produce a powerful current, and is easily cleaned by pouring water through it.

A large glass jar is sufficient to contain an apparatus of moderate dimensions, which is constructed as follows: The plates of zinc and copper, which are about ⅛ in. thick, are made as wide as the depth of the jar will admit, and 3 ft. long for a vessel 4 in. in diameter. The copper, being on the outside, is made a little longer. Any excess can be easily cut off with the shears. Lay between the sheets of zinc and copper and upon the latter strips of soft pasteboard about $\frac{1}{12}$ in. thick and as long as the plates, and clamp the pack between two iron bars about 1 in. wide and ¼ in. thick, fastened by a hand-vise at each end. After heating the metal to a moderate degree on the side thus fastened, beat the plates into a coil around the bars with a wooden mallet, which can be done by a tinner or coppersmith in a few minutes. The inmost turn will not be quite round, but that is of no importance. The pasteboard is then removed.

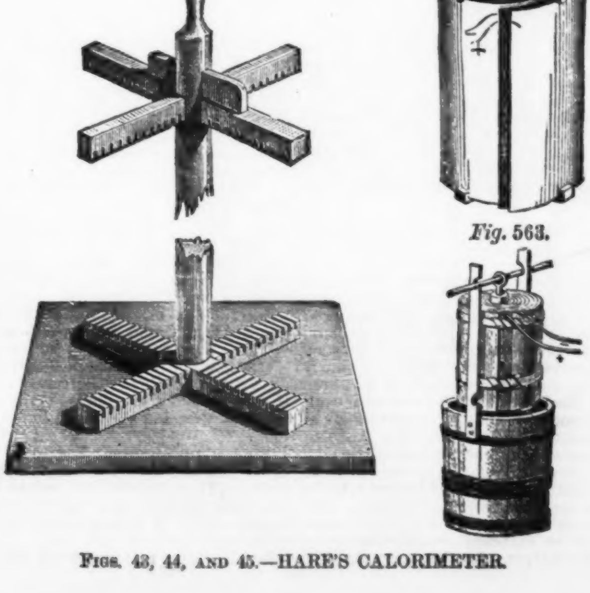
A wooden cross, Fig. 43, is wedged fast to the end of a round bar of proper thickness, in the upper part of which two square holes are cut to receive two other smaller bars at right angles to each other. These bars are let into each other, and one of the holes made twice as high as the other to admit them; they are fastened by a wedge. The distance between these crosses must be ¼ in. less than the width of the coil. This is placed between them, and the places where the plates touch the wood marked; grooves are afterward cut in these places to keep the plates apart. The plates can at any time be taken apart to amalgamate the zinc. The poles are formed by stout copper wires soldered to each plate. Fig. 44 represents the apparatus complete. For large coils wooden tubs are used, and arranged as shown in Fig. 45.

A single Wollaston's element, consisting of a single plate of copper and zinc, is very convenient for similar purposes when a strong current is not needed. A handle is fastened to the copper plate, and short copper wires soldered on as poles.

M. Trouvé's New Moist Battery.—This is a sulphate of copper cell, which has the advantage of working without a liquid, or, at least, without free liquid. Each element, as shown in Fig. 46, consists of a circular disk of zinc, Z, and a disk of copper, C. These are placed parallel and separated by a number of paper disks somewhat smaller in diameter. This mass of paper is capable of absorbing considerable water, and, hence, will remain moist for a long time. The lower half of the paper disks is soaked in a saturated solution of sulphate of copper, the upper half in a solution of sulphate of zinc. The sulphate of copper is scarcely used except during the passage of the current, and there is almost no work expended in the battery itself. The copper disk is held in the center by a rod insulated from the paper and zinc disks, which extends upward through a slate or vulcanite cover. The latter fits hermetically over the glass vessel, thus preventing evaporation.

It is stated that this battery remains constant for a year, needing no attention whatever. To renew it, it is sufficient to resoak the lower part of the paper in sulphate of copper. The sulphate of zinc being constantly formed by the action of the battery, never needs replenishing.

Fig. 561. *Fig.* 562. *Fig.* 563.



FIGS. 43, 44, AND 45.—HARE'S CALORIMETER.

When the zinc is used up a new disk is inserted, and it is best then to put in new paper.

The electromotive force is the same as that of the Daniell element. M. Trouvé has made many applications of this battery, notably to medical apparatus and to the purposes of military telegraphy. In Fig. 47 is represented the form for the latter purpose. The battery is composed of three hard rubber boxes, superposed, and each containing three elements. This has sufficient power to work a sounder over several miles. It may be carried upside down or in any position.

New Form of Leclanché Battery.—In this battery the depolarizing element consists of an agglomeration of powdered carbon, peroxide of manganese and gum-lac. This mixture, subjected to hydraulic pressure, forms the blocks seen on opposite sides of the carbon. The zinc rod is separated from the carbons by a triangular piece of rubber or other insulating material, and the whole is bound together, as

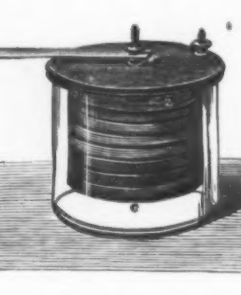


FIG. 46.

FIG. 47.

TROUVE'S MOIST BATTERY.

shown in the cut, by means of bands of rubber or other non-conducting material. It will be seen that there is a recess in the inner face of each depolarizing block. The internal resistance of the battery will not be greater than that of the liquid contained between the depolarized and the carbon plate.

It is stated that these batteries have been used in telegraphy for 18 months without attention.

These elements will rest indefinitely charged, the internal chemical action being null when the current is not closed. The depolarizing action of the agglomerated plate is so great that a single fragment clamped to a thin plate of polarized carbon is sufficient to depolarize it entirely in less than a minute.

Carbons.—A piece of clean coke, or a piece of carbon from a gas retort, may be used in these batteries. While it is best to buy the carbon from dealers in electrical apparatus, it may be prepared as follows: Take clean finely ground coke, mix with it pulverized coking coal, ram the mixture

FIG. 48.—NEW FORM OF LELANCHE BATTERY.

into an iron mould, and expose to the heat of a furnace until the gas is expelled from the coal. The mould and its contents are allowed to cool before the carbon is removed. The carbon is now dipped into a sirup of sugar dissolved in water, and subjected to heat, which is sufficient to carbonize the sugar.

Care of Carbons and Porous Cups.—After long use the porous cells and the carbons should be soaked in warm water.

Amalgamation.—The zinc in all batteries, except the Daniell and its modifications, must be amalgamated. This is easily accomplished by first dipping the zinc in dilute sulphuric acid (acid, 1 part; water, 15 or 20 parts) to remove scale and dirt, and afterward spreading on a little mercury, which soon spreads and covers the entire surface of the zinc.

Bunsen's or Grove's batteries may be amalgamated by pouring a few drops of mercury into each cell containing the zinc. The zincs will remain amalgamated as long as any mercury remains in the cell.

Volt.—The unit of electromotive force is called a volt. It does not differ materially from that of a Daniell cell.

Ohm.—The unit of resistance to the passage of an electric current is called an ohm, and is about equal to that of a cylindrical copper wire 1-20 of an inch in diameter (No. 20, Birmingham gauge) and 250 feet in length, or of 330 feet of iron wire, No. 9 (0·155 inch diameter) of average quality.

Weber.—The weber is an electrical unit by means of which electricians are enabled to convey definite information regarding the strength of a current. A volt divided by an ohm equals one weber.

NEW YORK PATHOLOGIAL SOCIETY.

November, 1878.

DR. J. C. PETERS, President, in the Chair.

A SURGEON LOSES HIS RIGHT HAND—REMARKABLE FORTITUDE.

DR. BRIDDON presented a second specimen, which consisted of the right hand, which had been severed by a heavy cutting-knife in a bookbindery. The victim of this unfortunate accident was Dr. Leavitt, of this city, who exhibited a coolness and fortitude under the great mental and physical strain which constituted the remarkable feature of the case. On the afternoon of October 29 the patient paid a visit to a bindery, in which he was pecuniarily interested; and while standing by the machine, accidentally set in motion, the knife came down upon his right hand, severing it just below the wrist and through the second row of carpal bones. Dr. L. promptly seized the stump, controlled the hemorrhage, covered the wound with bandages, and then wrapped the right hand in a towel and rode in a street-car from Fourteenth street to Fifty-first street, a distance of nearly two miles. Dr. Briddon was asked by Dr. Hadden to see the case in the evening, when a consultation was held with Drs. Hadden, Geo. F. Shrady, and Beckwith, resulting in a decision to amputate at the wrist-joint. During the consultation the patient himself discussed the practicability of merely trimming the stump and not sacrificing the carpus. The skin was so extensively separated from the dorsum of the wrist that it was impossible to cover these bones, there being barely enough integument upon the palm for a stump of the wrist. After the operation was determined upon the patient busied himself in arranging his room, in fixing the operating-table, and attending to many other details. He carried his personal interest in the operation to the extent of requesting that no ether should be administered to him. This wish, for obvious reasons, was not gratified. The amputation was performed in the usual way, and a flap was made from the palm of the hand.

EPITHELIOMA—BLEPHAROPLASTY.

DR. NOYES exhibited a small specimen of epithelial growth removed by operation from the eyelids, which was of interest in connection with the means used to fill up the gap which was left. The patient was a lady aged 50 years. Nineteen years ago she noticed a small growth on the inner border of the lower lid, near the punctum. This remained stationary for ten or twelve years, when it began to spread along the border of the lid and at the same time broke down in ulceration. Within the past year the disease extended itself over the lachrymal sac, involved the inner portion of the upper lid, and made in all a tumor the size of a hazel nut. Two-thirds of the lower and one-third of the upper lid were occupied by the disease as well as the adjoining side of the nose. The operation of removal was performed without difficulty, the tumor shelling out from the underlying tissues easily. The lachrymal sac was exposed, but was not opened. Actual cautery was employed along the inner portion of the wound. In order to fill up the deficiency of the growth occasioned by the extirpation, a vertical incision was first made in a line with the inner canthus and along the side of the nose to the reflection of the mucous membrane of the gum. From the outer canthus an incision was also extended horizontally across the malar bone to within a half inch of the ear. The flap thus created was dissected up and slid inward toward the nose, thus restoring the lower lid. A space was left on inner canthus and inner portion of upper lid. An attempt was made to fill up this space by transplanting a severed portion of skin from the arm, according to the method proposed by Mr. Wolf of Glasgow. But sloughing of this piece occurred, owing, as Dr. Noyes thought, to the fact that actual cautery had been previously used in that portion of the bed of the wound. Union occurred by first intention throughout the flap for the lower eyelid. A second attempt to fill up the vacancy of inner portion of upper lid was made shortly afterward. An incision from the upper limit of the gap was made horizontally across the root of the nose, and then at right angles downward. The flap thus created was turned upon itself edgewise and accurately adapted to the edges of the gap. Her recovery was complete and satisfactory. The tumor was examined by Drs. Bull and Satterthwaite, and found to be an epithelioma.

REMOVAL OF MELANOTIC EPITHELIOMA FROM EYEBALL, SAVING THE EYE.

DR. NOYES presented a small malignant tumor which he removed from the exterior of the eyeball, and at the same time preserved the eye. The patient was a gentleman, aged forty-eight years, who first noticed a small black speck on the white of the left eye seventeen years ago. This remained stationary for twelve years, and then grew slowly for five years. Within the past year the increase had been very rapid, presenting a black raspberry appearance, overlapping the outer third or more of the cornea and nearly as much of the adjacent sclerotic. On looking at it, the first impression was that it grew from the interior of the eye; but a closer examination showed that the eye was perfect, and that the eyeball was not affected. The patient came to Dr. Noyes after having seen other ophthalmologists, who advised enucleation of the eye. It struck Dr. Noyes, however, that the tumor could be detached from the surface of the globe, and he accordingly made the attempt. The operation was performed by a curved scissors, and was entirely successful. The tumor grew from the episcleral tissue and from the limbus. The surface of the wound was easily covered by dissecting up the edges of the conjunctiva and bringing them together. The growth was examined by Drs. Bull and Satterthwaite, and found to be a melanotic epithelioma. Dr. Noyes concluded the presentation of this interesting specimen by an exhaustive review of the literature of the subject.

IMMENSE VESICAL CALCULUS.

DR. WEIR presented an immense vesical calculus removed by Dr. C. T. Gardner, of Providence, R. I. It weighed twelve and a half ounces, measured in its several diameters three and three-eighths inches, three and one-eighth inches, and two and a quarter inches, and had for a center a small oxalate calculus, the periphery being made up of phosphates. The operation for its removal was commenced with the lateral incision, but was afterwards extended into the bi-lateral section, as the instruments on hand were insufficient to crush it *in situ*. The patient, a man of 49 years, did well after the operation; a rectal fistula that formed from sloughing spontaneously closed.

Until he had looked this afternoon into Eve's "Surgical Cases," Dr. Weir was under the impression that the stone exhibited was the largest that had successfully been removed entire in this country by the perineal section. But he found in that work a record of a calculus removed by Dr. Mettauer, of Virginia, weighing sixteen ounces, with recovery of the patient. Abroad, Mr. Hadmer, of Norwich, England, has the credit of having in 1746 successfully extracted a stone weighing nearly fifteen ounces. Mr. Mayo, of Winchester, England, removed one of fourteen and a half ounces, but it was broken before extraction.—*Medical Record.*

ORIGIN OF YELLOW FEVER.

AT the recent meeting of the American Public Health Association Dr. A. N. Bell, of New York, remarked in substance, as follows:

During my naval service in the Mexican War, and subsequently on the Gulf Coast, the Spanish Main, in the West Indies, on the coast of Africa and neighboring islands; and since, on Bay Ridge and Fort Hamilton in 1856; in charge of the floating Yellow Fever Hospital, and my connection with the New York Quarantine—at home and abroad, ashore and afloat—I have, like my friend, Dr. Dowell, seen a good deal of yellow fever, and had excellent opportunities for studying its topography in various places. And during the while I have read everything concerning it I could get hold of, but with convictions the very opposite of his. I am thoroughly of the opinion that the conditions of yellow fever are, in general, putrefying organic matter, moisture, and high temperature, and wherever these conditions combine in the greatest abundance, there yellow fever is most wont to prevail, and with the greatest degree of malignancy. And so far from having my convictions shaken in this regard by the reports we have here heard, they have been greatly strengthened. Filthy soil, foul water, foul traffic, foul vessels, and high temperature have been the prevailing conditions throughout. And under these conditions, on evidence which I feel bound to accept, I believe the disease frequently has occurred *de novo* in the United States.

Of its history on this continent, and in the West Indies, it has been contemporary with European settlement. Oviedo records a great mortality from it among Columbus's people in St. Domingo in 1494. Herrera, Ulloa, Ferreyra de Rosa, and other Spanish and Portuguese historians all make record of yellow fever in American settlements before there was any commerce between this country and Africa, or any other alleged primitive sources of this disease. And in more recent times, but yet so long ago that commercial intercourse was much more easily traced than during the last fifty years, yellow fever frequently occurred in various parts of this country, when favored by local conditions, in exceptional seasons, when it was wholly impossible to trace it to foreign origin, and under similar circumstances I hold it is continually liable to occur.

All efforts at freezing out infected ships hitherto have failed. The cold cannot be made to penetrate into the bilge, the timbers, and crevices, the places in which lodge the deposits of soakage from the filthy waters of foul harbors in hot climates. Moreover, it is the common practice of the navy, in sending infected vessels to cold climates, to have them hooded over, and the depth of the hold and the housed-in conditions are such as to preclude the possibility of a freezing temperature where it is especially needed. Dr. Bell expressed his continued faith in *steam* heat as a disinfectant for ships, and his surprise that it had not been used on board the ill-fated Porter. The fear of moisture on account of condensation of the steam, he says, is a fallacy; the surfaces thus subjected to steam become so heated that, immediately on opening the hatches, the moisture is dispelled with great rapidity and completely. Of the degree of heat necessary to kill yellow fever, he considers steam heat of 180 degrees for two or three hours amply sufficient. Dr. Bell here related his first observation in the use of steam with the effect of disinfection in 1848. The United States steamer Vixen, while infected with yellow fever, was steamed for the purpose of killing cockroaches. The result was twofold, the death of the vermin, and non-recurrence of the fever. Since that time it had frequently been used by himself and others for the special purpose of disinfection, and, so far as he knew, without failure in any instance.

PHILADELPHIA HOSPITAL.

Clinic of DR. F. F. MAURY—Reported by Dr. C. W. Dulles.

SINUS OF THE LEG.

ON the inner aspect of this young man's leg you see two openings, with purplish, unhealthy-looking margins, from which a small amount of semi-purulent matter can be pressed. The origin of this trouble he associates with a gunshot injury, and it has now lasted a long while.

The appearance of the openings would lead us to suspect —especially in this location—that they communicate with dead bone. If this be the case we must remove it; if not, if we have but a sinus here, a free incision will enable us to ascertain this, and also put it in the best condition for healing.

We begin by applying Esmarch's bandage. This consists of a roller of rubber, which is applied tight, and without reverses, from the very extremity of a limb to a point above where an operation is to be performed; and a piece of rubber tubing, which is drawn very firmly about the limb several times and fastened just above the last turn of the roller, which is then removed from this point downward. The

roller drives out of the limb almost every particle of blood, and the tube, acting as a tourniquet, prevents its return. We thus have the means of doing tedious, and otherwise bloody, operations without any hemorrhage to interfere with our work or hide it from our eyes. This is of special value in operations upon the bones, and I consider Esmarch's bandage as one of the greatest achievements of modern surgery. For my own part, I may say, too, that I have never seen any evil results from its employment, such as other surgeons have reported, and have no fear of it.

Now, in proceeding with our operation, I make a free incision between these openings, as I have over and over again charged you to do. Make an exploratory incision in the skin, free. Don't be afraid. Then I examine with my finger—the best probe possible—the bottom of this tract, and I find no dead bone; we have only a sinus here. I now scrape out a large quantity of cacoplastic lymph to freshen the walls of the sinus, and put it in a good condition for repair.

In all this, you see, there has not been a drop of blood lost—not a drop. But now, as my resident slowly loosens the rubber tube, you see the pallid limb growing rosy. The blood is returning to it, and comes welling up from the raw surface I have made. I do not check this at once, for I believe the depletion will do good; but after it has continued for a while, if it do not cease spontaneously, we will insert a piece of sponge soaked in equal parts of Monsell's solution and water, and leave it in for a day. In this way we shall expect to secure the healing of this sinus before long.

CURE OF ONYCHIA MALIGNA.

DR. GAETANO (*Journ. des Sci. Med.*, from "*Il Morgagni*") was called to a little girl ten years of age who had suffered horribly for six months with peri- and subungual ulceration of the right index finger. Having softened and raised up the nail as much as possible, he dropped a concentrated solution of morphia upon the sore, with which he kept it in contact a quarter of an hour. He then covered the diseased part with very finely-powdered nitrate of lead and enveloped the finger with a bandage. The pain was almost immediately relieved, and the patient slept soundly that night for the first time in a long period. The bandage was removed at the end of five days, and the ulcer was found about one-half healed. The application was repeated, and by the end of five days more complete cicatrization had taken place. In two other cases results as favorable were obtained by Dr. Gaetano, the applications being made more or less frequently as the case seemed to demand.—*Amer. Med. Bi-Weekly.*

TRADE DISEASES.

FROM a comprehensive view of the circumstances directly answerable for the production of disease, Dr. Arlidge constructs the eight following classes, some of them of wide-spreading influence, others of very limited operation. In his recent address before the British Medical Association, so far as they refer to manufactures and the arts, they are called "trade diseases."

1. The evolution of dust.
2. The evolution of unwholesome vapors and gases.
3. Materials of an irritant or poisonous nature acting through the system or only locally.
4. Over-heated air, whether dry or laden with moisture.
5. Compressed air and rarified air.
6. External conditions acting upon the organs of special sense.
7. Over-exertion of particular parts of the body.
8. Mechanical appliances productive of bodily injury.

The most widely spread source of disease flowing directly from the labor pursued is assuredly the evolution of dust. Its presence and action are observed in all textile factories; in potteries; in mining, whether for coal or metallic ores; in cutlery manufacture; in cutting and polishing stone, ivory, and mother-o'pearl; in the grinding of flour; and, in fact, in many other small trades that need not be specified. The other causes are, however, wide-reaching, and not a physician but can recall cases brought about by them.

It will be noted that all or nearly all of them are preventable; and were the attention of inventors more prominently called to the matter, and stimulated by offers from those interested in the good of the community, no doubt there is hardly a trade but could be prosecuted innocuously. There is here a field for practical philanthropy which asks cultivation, and the benefit of any discovery in which will extend world wide. As it is an excellent mode of stimulating investigation, will not some one offer a "prize" for the most useful discovery in this branch?—*Med. and Surg. Reporter.*

KEEPING FRUIT.

AT a recent meeting of farmers and others for the discussion of the keeping of fruit, the following items of experience were brought out, which, if facts, may be of some interest to many of our readers.

Apples packed in calcined plaster rotted very badly and quickly. The dry plaster absorbed enough moisture from the apples to dampen it and get up a degree of heat sufficient to spoil the fruit. Dry earth kept apples in fair condition to appearance, but the flavor was spoiled. Buckwheat chaff had been found excellent for packing fruit, as it contains very little starch. Wheat bran is objectionable on account of its abundance of starch, which soon moulds and spoils the fruit. Dry, forest leaves have been used with fair results for packing apples. Oak leaves are among the best for this purpose. Several bushels of fall apples having been stolen by a hired man, were buried in a large hay mow and then deserted for several months. In mid-winter they were discovered and found in a very good state of preservation. Taking a hint from this, fifty barrels of winter apples are now packed in straw in a cool, dry cellar as an experiment. Apples are so cheap and plenty this season that it costs very little to try an experiment, which if successful, may prove of great value. Cellars should be ventilated at the bottom, that the whole of the air may be changed. A brick taken out from the bottom of the chimney flue makes a good opening for the escape of damp air in a cellar. Dry sand had been successfully used for keeping grapes from harvest time till winter.

One gentleman showed a squash which had been kept in a warm closet, apparently sound, for nearly two years. Several experiments were reported in attempting to change the bearing year of apple trees, but generally with little success, owing to the depredations of insects which multiply so largely in bearing years, and are always ready to destroy the whole crop on the following year, when the product is limited.—*N. E. Farmer.*

[AMERICAN MILLER.]

A STUDY OF WHEAT.

THE old theory, that says the best mechanics in the world are those who work most faithfully from morning to night at the drudgery of their work, and know or care for nothing else, is fast giving way, and to-day that mechanic can obtain the best situation who is most thoroughly acquainted with his work, in all the minuteness of its details, having a complete knowledge—from the intricate mechanical problems down to the mere drudgery of the business. Is there any class of workers to whom this can be applied better than to the miller?

A miller who desires to be considered successful—not particularly from a money point of view—should be familiar

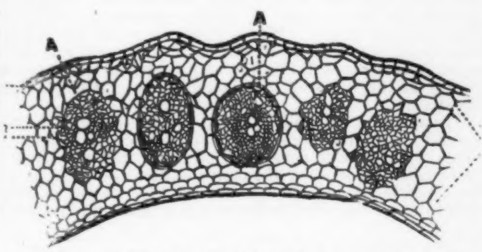


FIG. 1.—CROSS SECTION OF WHEAT STRAW.
A, Vascular Bundles. *B*, Spiral Vessels. Drawn with Camera Lucida, X 75.

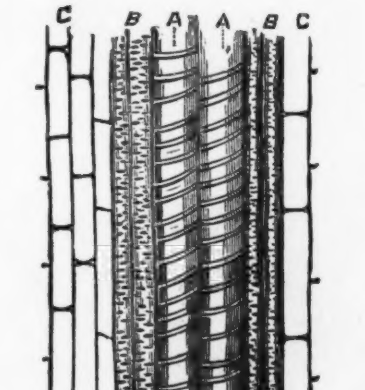


FIG. 2.—LONGITUDINAL SECTION OF WHEAT STRAW.
Showing a Vascular Bundle. *A*, Spiral Vessels. *B*, Pitted Vessels. *C*, Regular Parenchymatous Cells. Drawn with Camera Lucida, X 375.

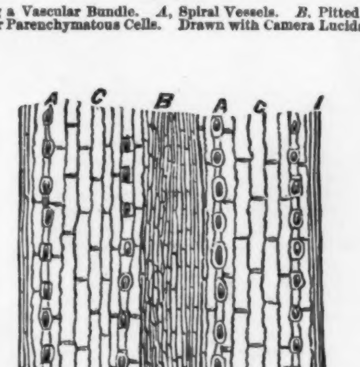


FIG. 3.—EPIDERMIS OF WHEAT STRAW.
A, Rows of Stomates. *B*, Opposite, or over the Vascular Bundles seen at *A*, Fig. 1 Drawn with Camera Lucida, X 75.

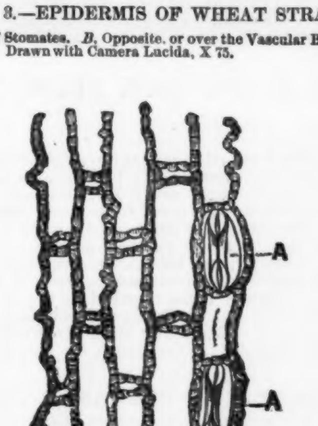


FIG. 4.—EPIDERMIS OF WHEAT STRAW.
Same as Fig. 3, magnified more. *A*, Stomates or Breathing Places. Drawn with Camera Lucida, X 375.

with the structure of every part of his mill—know the power of the stones—just how much margin he has for safety in the steam boilers—know how much strain can be brought to bear on the great leather belts, and be able to recognize and remedy at once any defect. He should know what grains he can run through his mills with safety, either to the mill or to his reputation as a miller. If it is his ambition to have the purest flour in market, he must know just what wheat to accept, not only the variety of the wheat, but the purity of that wheat, for the very best variety of wheat will not give pure white flour if the greater part of it is smut, or if it has been troubled with any of the numerous parasites which live on wheat. Then, for these reasons, our model miller should have a knowledge of the different diseases to which wheat is subject, such as smut, blight, rust, mildew, brand, and ergot. A study of these diseases, together with the history, geographical distribution, and microscopic structure of wheat, will constitute the present series of articles.

Wheat has been cultivated from the earliest antiquity, and now furnishes the principal breadstuff of all civilized countries. It is not known to what country it originally belongs; some even have claimed that it was planted upon the earth at the time of the Creation. It is certain that it was cultivated in Egypt nearly two thousand years before the Christian era, as we read in the Old Testament, and Chinese history tells us wheat was introduced into China 2,700 B. C. by one of the Chinese emperors. In every country where wheat would grow at all, it has steadily increased in proportion as the country has become civilized and settled. Hostile armies have aided in transporting it from one country to another, and Mexico owes its first introduction of wheat to the brutal conqueror Cortez. It was introduced and cultivated in Peru under the directions of the Spanish lady Maria de Escobar, and the North American Colonies began to cultivate it at the earliest period of their settlement. It was first sown on the Elizabeth Islands, of Massachusetts, by Gosbold, at the time he explored the coast, in 1602. It was sown in Virginia, together with other grains, in 1611, however it was not cultivated to any great extent, because the raising of tobacco was entered into with so much zeal; but in 1651, a premium was given for its culture, when it received a great impetus.

In 1620, wheat, together with rye, barley, and other grains, was exported from Manhattan Island to Holland. It was first introduced into the valley of the Mississippi in 1718. The New England States and New York did not raise scarcely any more wheat than necessary for their own use until after the Revolutionary war, but large quantities were exported from New Jersey to Europe, and from Illinois to New Orleans. The price per bushel in 1635 was sixty cents, while in 1680, in Maine, it was sold for $1.25. At the present time wheat is cultivated over nearly the whole world, being limited only by the rigid cold of the North, and the intense heat of the South. We find it exported in large quantities from the United States, Russia, Hungary, Turkey, Denmark, and Chili. Next to the United States, it is most extensively cultivated in Russia. The great increase in the Pacific States is worth noticing. In 1850, only 17,200 bushels were raised. Now, we are told, there are many farms of from 2,000 to 4,000 acres, while farms of from 20,000 to 40,000 acres are by no means few, entirely given up to the growth of wheat. This is due principally to the fact that the summers are long and devoid of heavy rains.

Regarding wheat with a botanical interest, we will find it in the family of *Gramineæ*—the family of grasses—and belonging to the species *Triticum vulgare*. Of this there are two distinct sub-species, known as Summer and Winter wheat—the Summer, *Triticum æsticum*, and the Winter, *Triticum hybernum*. Each of these sub-species is divided into many varieties, as Treadwell, Diehl, Clawson, Tappahannock, etc. In wheat *Triticum* there is but a single spikelet at each joint; its two glumes placed transversely, and it is from three to several flowered; the lower palet is pointed or furnished at the tips with awn, of variable length; stamens, three. The sub-divisions into Spring and Winter, seem to be the result of cultivation more than anything else, for several different experimenters have been able to produce the Winter variety from the Spring, after several successive trials, and the reverse is also true.

De Candolle—a botanist of high authority—believes wheat to be the result in growth of the cultivation of a wild grass. He even claims that this grass is still growing in certain localities in Central Europe. Many different varieties have been cultivated. One gentleman in France, who has experimented largely with this grain, has succeeded in raising 322 entirely different varieties. The difference between varieties consists in the size of the plant, its shape, habit of growth, in its foliage, in the size or shape of the spike or head, and in the size, form, color, and heaviness of the grain.

There are about twelve varieties in this country. The same variety is found in different localities under different names, so we have many purely local names. So a certain variety may grow luxuriantly in one locality, and be nearly, if not quite, a failure, in another, due to the soil, climate, and various other causes, singly or combined. But all farmers know that a good soil is as necessary for a good yield of wheat as for any other grain. Of course, pure, clean seed is a most indispensable aid to insure a fine crop, and plenty of skill should be exercised in keeping out all foreign seeds. The weeds which are the most troublesome to wheat are cockle (*Hychnie githago*), and chess or cheat (*Bromus secalinus*), which is sometimes so abundant that some farmers take it to be degenerate wheat. In New York a great deal of trouble is experienced from the presence of redroot or gromwell (*Lithospernum averese*). Then wheat is troubled with rust, smut, the weevil, the Hessian fly and wheat moth.

Wheat retains its vitality only from three to seven years, and the stories, so generally believed, of wheat being found in Egyptian mummies, thousands of years old, capable of growth, etc., are now discredited. It is believed the cunning Arabs hide these seeds there to deceive the unsuspecting and susceptible traveler, for very recently there have been found Indian corn, and dahlia tubers, exhibited by these sons of the desert as grains and roots which for centuries have been quietly sleeping, waiting only for moisture and sunlight to awaken them to life and growth. 'Tis fortunate for the happiness of our poor Arabs that they are entirely ignorant of the fact that Indian corn and dahlia tubers were not known until after the discovery of America.

Before we take up the minute structure of wheat itself, let us study the microscopic structure of the plant, for every part shows beauties under this aid to the eye, which, without it, would never be mistrusted to exist. Every part of the stem, the root, and head, and seed, would, of itself, form a study, but with limited time and space we can at most only hope to obtain a general idea of the minute structure of each part. Many interesting questions could be answered here, were we not intending only to give the microscopic structure, as: How does wheat grow? How does it assimilate the elements, even minerals, of the soil, transforming material so unlike itself and storing away its starch in the tip of the root at one end and in the center of the kernel at the other? How is moisture gathered from the soil and carried to the extreme end of the head? All these and similar questions are found well explained in our veg-

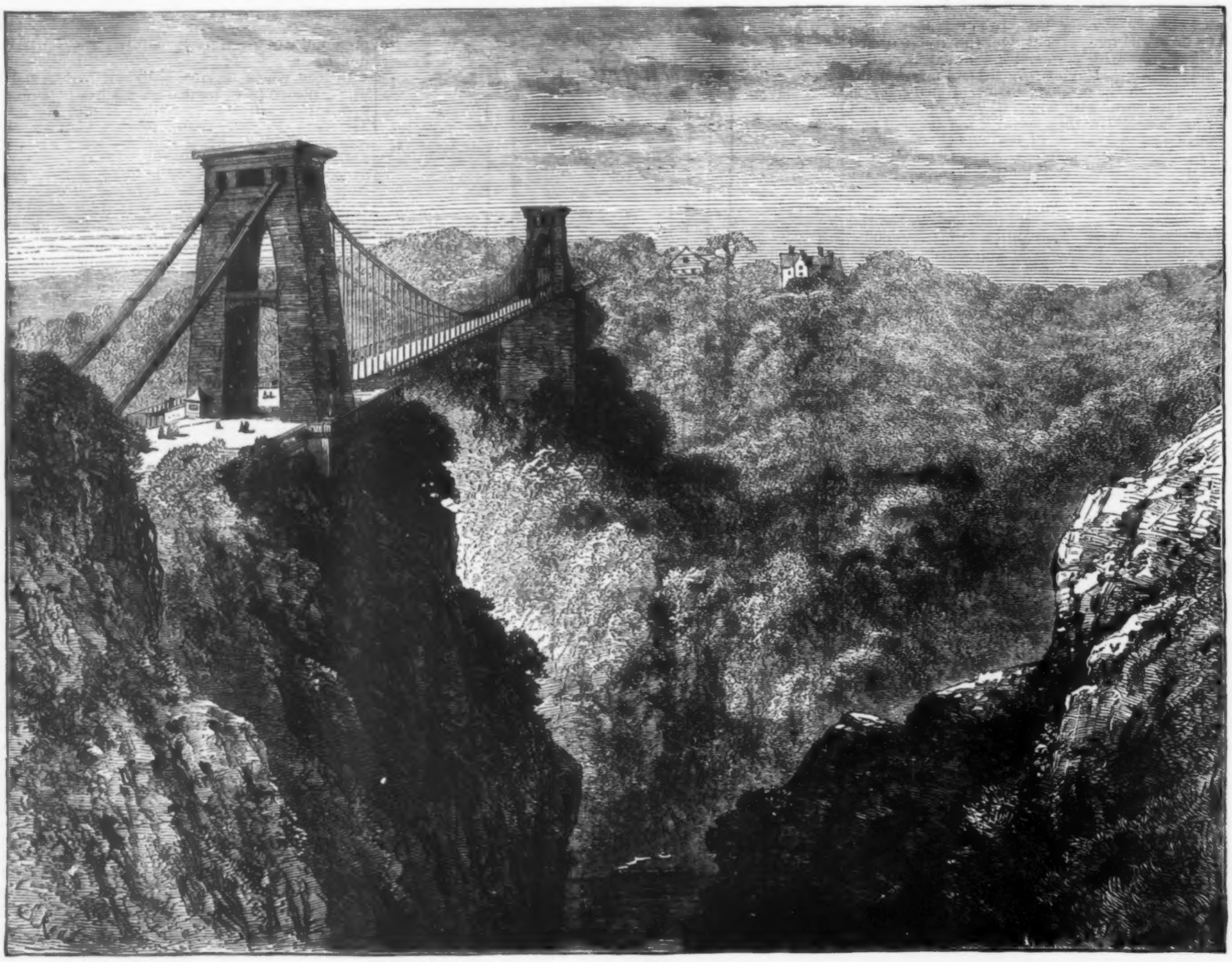
stable physiologies, and to these works are our readers referred, while we proceed to give the results of original work, commencing first with the structure of the straw or stem.

If we take a wheat straw that has been soaking in water for twenty-four or thirty-six hours, and with a very sharp razor make a cross section and examine under a microscope, magnifying from 75 to 100 diameters, we will be able to form a very correct idea of the structure of the stem. Only a part of such a section is shown in figure 1—this being but a small segment of the circle, which, when complete, forms the entire circumference of the straw. The whole structure is made up of vegetable cells, only many are modified differently in order to fulfill some special object for which they were made.

The principal framework of the straw is built up of such cells as appear at *D*, very thin walled hexagonal cells. These cells are modified in shape as they approach both the inner and outer edge of the figure. At the inner edge we see regular four sided, thin walled cells; as they reach the outer edge we find the walls quite thick and the cells also four sided. The row of cells as seen at *C*, form the epidermis of the straw, and is composed of a simple layer. The outer edge of these cells is quite thick walled, and forms the cuticle. This cuticle is what gives the smooth polish to the surface of the straw. In some varieties of wheat this cuticle is much thicker than in others. If the season is a long, cold, stormy one, or if the wheat grows in a cold climate, the cuticle will be found to be thicker and more leathery. The darker round portions of the figure, as seen at *A*, are bundles or ridges found running lengthways of the straw. The larger cells, at *C*, are found covering the grooves seen in the depressions in Fig. 1 between the vascular bundles. At *A*, we find peculiarly modified cells surrounding openings that are the regular breathing places, called stomates. The wheat plant must be able to breathe, to exchange gases with the surrounding air, to throw off a superfluous amount of moisture or to absorb moisture from the atmosphere when the earth is too dry to supply its demands.

These stomates are seen in Fig. 4, highly magnified. The dark line at their center, *A*, is where the opening occurs, here represented as closed. As the wheat is growing in the field if a dry, hot day comes, these openings will be found closed tightly, in order to retain all the moisture possible in the plant. If the day is damp, the little mouths will open as wide as possible to exchange moisture with the surrounding atmosphere. We have proved this many times by careful microscopic examinations at such times. Where this power of moving resides is not at present fully determined, but true it is these little stomates guard the life and habits of this plant as closely as the windows of a house protect the inside from the storm.

The question of utilizing wheat straw has not been acted upon to any great extent by our American farmers. In some countries it is considered of great commercial value. In Ecuador the most of the native women and children are employed in picking and sorting straws for market. Large quantities are imported to America to be made up into straw actual rents are comparatively unknown, and a larger proportion of the people own their own houses than perhaps in any other city in the world. This secures a staid, thrifty population, and, with a mild climate, cheap fuel, cheap food, and cheap clothing, gives Baltimore a great advantage as a manufacturing city.



BRISTOL, ENG.—THE CLIFTON SUSPENSION BRIDGE, FROM ST. VINCENT'S ROCKS.

the woody portions of the straw, or, as they are called, vascular bundles. The fine cells forming the most of these bundles are woody cells, while the large openings near the center of these bundles are the cross sections of large vessels or ducts that run the whole length of the straw.

Fig. 2 represents a longitudinal section of a vascular bundle. The cells shown on either side of this bundle, at *C*, are the fundamental cells seen in cross section at *D*, Fig. 1. The cells at *B* are the woody portions seen at *A*, in Fig. 1. They have very peculiar little pits covering their surface. The large vessels at *A*, Fig. 2, are the same as those seen in the cross section at *B*, Fig. 1, only magnified many times more.

The spiral bands arranged so beautifully around these vessels are little fine tubes, coiled around on the inside of the large vessels, and growing firmly to the inside wall. Water or moisture is carried the length of the straw by this spiral tube, as well as being absorbed through the cell walls.

The only object of the woody portion of the straw is to give strength enough to the plant to hold up its head until the wheat is ready for the harvest. The spiral vessels and woody portions do not, as many suppose, carry the sap through the plant. The sap is carried right through the cell walls by absorption, principally by those cells found at *C*, Fig. 4, and at *D*, Fig. 1. In order for the sap to be raised one inch, it is obliged to pass through over two thousand of these cells.

Fig. 3 shows the epidermis covering the outer surface of the straw. It has been torn off lengthways, and is the single layer of cells seen at *C*, Fig. 1. The long, narrow cells at *B* make up the epidermis as it covers the vascular work, but the most of it is made up into hats and fancy work before being exported. In Tuscany a peculiar variety of wheat is cultivated, solely for its straw, known as *Triticum turgidum*. It is noted for its great length, slenderness, and strength. The seed grain is grown in the Apennines, and the straw crop on the low lands. The plant is cut before maturity, and left on the ground to dry in the sun. It is then tied in bundles and stalked. It is afterward spread on the ground to be bleached by the sun and dew, and then steamed and fumigated with sulphur, sorted, and plaited.

MRS. LOU REED STOWELL,
Microscopical Laboratory, University of Michigan.

BALTIMORE HOUSES AND RENTS.

IN the treatment of its real estate Baltimore is peculiar. Its slow and uniform growth has led to a very general system of leasing land for "ninety-nine years, renewable forever," at an annual ground rent of 6 per cent. on its market value at the date of the lease. For example, a common laborer or mechanic, who can command money enough to build a house, instead of buying a lot upon which to build, leases it. If the lot be worth $1,000, he pays annually forever a ground rent of $60. If he builds a house that costs him $1,000, as money here is 6 per cent., this makes his house rent practically only $120 a year. This is, in effect, to loan him the value of the lot at 6 per cent. If the lot advances in value he has the benefit of it, since, if he wishes to sell, he disposes of his house at its market value, and the ground lease at its enhanced price.

This encourages men of small means to live in their own houses. As a consequence, there are no tenement houses,

QUAINT ARCHITECTURE OF OLD BRISTOL, ENG.

OUR illustrations of some picturesque remains of antique domestic architecture, which we have called "Bits of Old Bristol," drawn by Mr. S. Read, will be acceptable to many readers. In the gable-fronted, half-timbered houses of King street, Maryleport street, and Pithay, with their overhanging upper floors, their oriel windows filled with square mullions and surmounted by penthouse lids, thoroughly breaking up the lines of horizontal extension, we see the ordinary character of Elizabethan town or street architecture, retaining some trace of Tudor Gothic or perpendicular traditions, which thus seem to have proved as congenial to the modest uses of common popular and domestic life as to those of stately ecclesiastical and palatial magnificence. The old city was formerly called Bristow, or Brigstow, which means "the Place of the Bridge," as we find a "Bristow street" in Edinburgh, and in other towns. It stands at the confluence of the Frome with the Avon, eight miles from the sea; and the new port of Avonmouth, with its capacious docks, bids fair to take its full share of maritime commerce. The trade with the West Indies, and the manufacture of sugar as well as its importation, have long contributed to the prosperity of Bristol, which has, nevertheless, lagged far behind Liverpool and Glasgow in the race of mercantile enterprise during the past half century. In the more troublous and adventurous periods of our national history, this sturdy and active old city of the West has borne a conspicuous part; in the wars between Stephen and Matilda, the Barons' war against Henry III., the dethronement of Edward II. and that of Richard II., and the Civil Wars of Charles I. with the Parliament, when Bristol was stormed by Prince Rupert, and was recaptured by Fairfax two years afterwards. The Cathedral, with the Bishop's see, was founded by Henry VIII. upon the dissolution of St. Augustine's Abbey.

The pleasant, salubrious, and rather fashionable suburb of Clifton, with the adjacent Clifton Downs, Durdham Downs, and St. Vincent's Rocks, and with the once famous medicinal spa called "The Hot Wells," situated beneath those heights on the banks of the Avon, has long been a favorite place of residence for quiet and leisurely people. The river here separates Gloucestershire from Somersetshire, flowing through a grand gorge, 250 feet deep and 600 feet wide, between precipitous limestone cliffs, on the one side, and the lovely hanging woods of Leigh Court and Nightingale Valley on the other. It is spanned by the noble chain suspension-bridge, which was completed, some fifteen years ago, with the materials of the Hungerford Suspension Bridge removed from London. This work is chiefly remarkable for the immense amount of masonry in the supporting piers, especially that on the Somersetshire side.—*Illustrated London News.*

IN PITHAY.

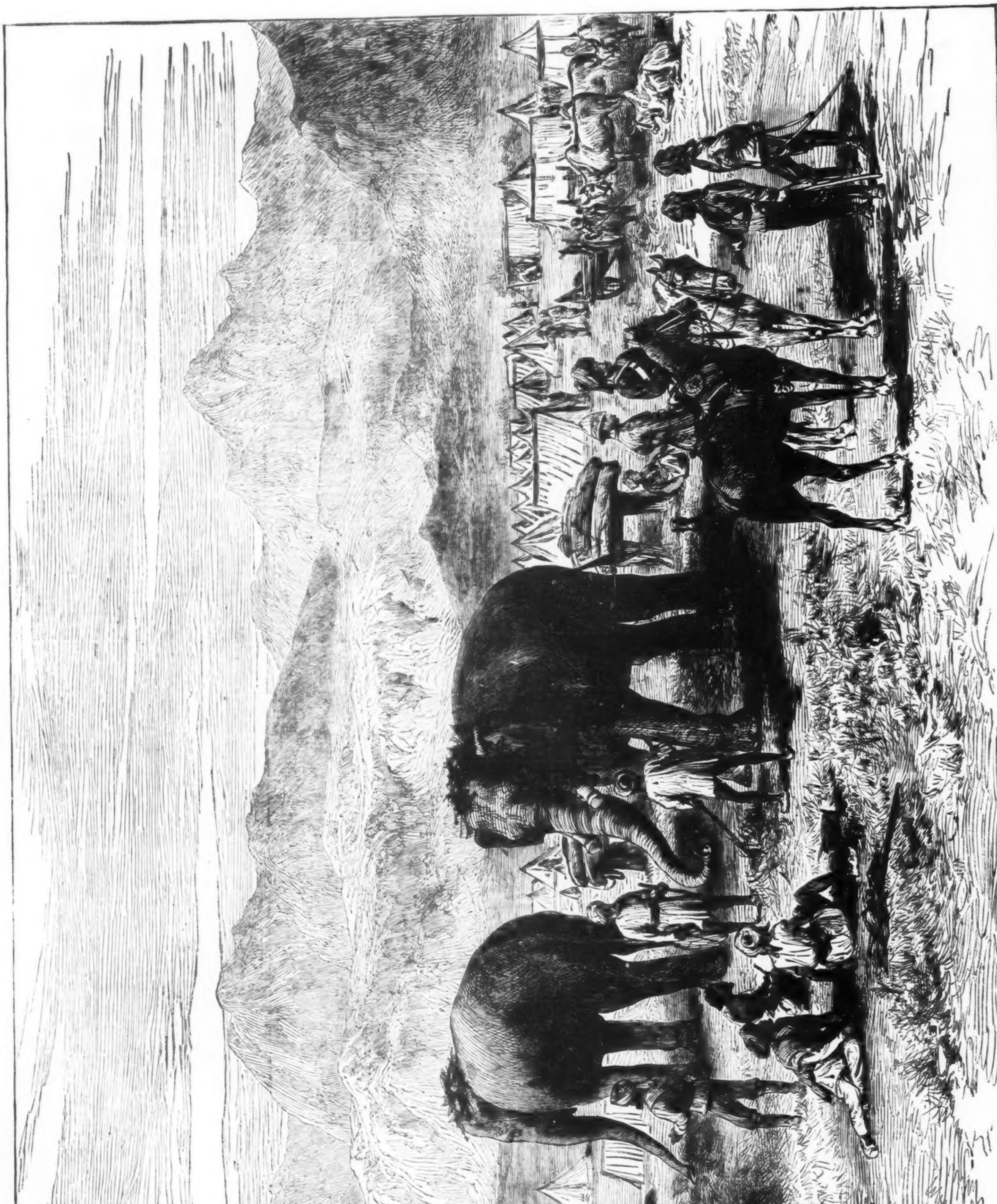
MARYLEPORT STREET.

KING STREET.

KING STREET.

REDCLIFF STREET.

QUAINT ARCHITECTURE AT BRISTOL, ENGLAND.



MILITARY ELEPHANTS PERTAINING TO THE BRITISH ARMY IN AFGHANISTAN.—MOUTH OF THE KHYBER PASS.

MILITARY ELEPHANTS ON THE MARCH.—BRITISH ARMY IN AFGHANISTAN.

THE UTILIZATION OF THE ELEPHANT.

THE popular books of natural history are full of stories of the sagacity, docility, and usefulness of the elephant of India. Indeed, persons who have seen these huge beasts only as curiosities in traveling shows and public gardens can have but a faint idea of the varied employments to which they are put in their native country, in peace and in war, in political pageants, and in practical industries. Those figured in our illustrations are part of a force of elephants attached to the British army in Afghanistan.

In view of the immense strength and remarkable intelligence of the elephant, the wonder is that their use has been so long confined to India. True, it has been assumed that they would not thrive in other lands, that they require luxurious feeding, and that nothing can be done with them except by Indian attendants—reasons enough, if they were true, to justify the present narrow limit of their employment. Recent experiences in Africa, however, clearly show that the alleged objections are unfounded.

Some years since a number of Indian elephants were sent as a present to the Khedive of Egypt. They were kept in a public garden until the cost of feeding them became intolerable, then, at the suggestion of an American officer of the Khedive's army, they were sent up the Nile to have their utility tested. After amusing the people at Khartoum for some months, they were sent to Sobat, in charge of a Dalmatian named Marco, the Indian attendants having had enough of the White Nile, and turned over the care of the strange beasts to negro soldiers. The journey up the Nile was made without difficulty, the elephants swimming the river readily when required, carrying their attendants on their backs. The severest test of the endurance of the elephants occurred in the subsequent march from Sobat to Bahr, across the country, a piece of ground never before traversed by European or Arab. It took eighty-one days to reach Bahr, and the party suffered much on the route. They took provisions for only twenty days, expecting to get supplies from the natives. This, however, was a mistake, as the people all ran away when they saw men riding on elephants, fearing the devil himself had appeared in their country. The elephants swam many streams and lakes, and at last reached Bahr, where fresh supplies were got. From Bahr they went next to Lado, a ten days' journey further on, and some time after to Dufli, where, at last reports, the elephants were employed in carrying all sorts of heavy goods.

Sir Samuel Baker thinks the experiment extremely valuable, since it proved that the Indian elephant can live in Africa, that it need not be fed in the luxurious manner thought indispensable in India, and that Indian attendants are not required.

"The chief obstacle to African explorers is procuring porters," Sir Samuel goes on to remark; "but who would require these if he had fifteen or twenty elephants? I may be a little too enthusiastic about the matter, but, from all I hear from Mr. Marco, I really think Africa might have been explored a hundred years ago with the aid of Indian elephants. At least, one can go so far as to say that, in expeditions where money is not so much the object—for instance, expeditions like Lucas's, Stanley's, etc.—elephants ought in future to be employed."

It has also been suggested recently, in the *Colonies, and India*, and later in *Nature*, that the elephant of Africa might also prove of value if properly domesticated. The first-named journal states that elephants are numerous in the interior of Cape Colony as well as in Central Africa, yet no one seems to have attempted to catch and tame them.

The subject has already been mooted that there is a good field for their use both in Central Africa and in Cape Colony, and that they would prove a new and important method of opening up and utilizing the wealth of the colony, and of furthering the explorations in Central Africa which are now of such general interest.

Mr. J. Fayrer, well known as a writer on Indian natural history, remarks in *Nature* that the African elephant differs from the Asiatic in some points, but is equally well adapted for labor, and when tamed has proved to be as docile and submissive and as free from vice as the elephant of India, and, Mr. Fayrer thinks, would prove as useful, if properly trained.

It appears that a troop of wild elephants has been observed within fifty miles of Port Elizabeth—on these the attempt might first be made—and it is well known that they abound in Central Africa, where, indiscriminately slaughtered for the sake of their ivory, the destruction of these animals is so great as at no very distant period to threaten their extinction. It seems worthy of consideration whether it would not be better to attempt to utilize them as beasts of burden, as is done in India, where they are of inestimable service to the Commissariat, the Public Works Department, the planters, and many others.

Mr. Fayrer suggests that the importation of one or more of the numerous officers who have been trained to the work of catching and domesticating wild elephants in India, with a fitting establishment, and perhaps a few Indian elephants to commence the work, would very soon put the value of the undertaking to the test, and probably show that a vast source of working power now unused might be made available.

MILITARY ELEPHANTS.—A BRITISH ELEPHANT BATTERY IN INDIA.

ON THE DEVELOPMENT OF THE GARPIKE.*

THE gar or bony pike of North America is one of the most interesting of living fishes. The best known species of the genus to which it belongs is the *Lepidosteus osseus*. This species owes the grammatical form of its scientific name, and, indeed, its first scientific description, to the elder Agassiz, and we have now to record the filling up of the last details of its life-history to the younger Agassiz. Known for over three-quarters of a century, it has been only within the last few months that the young fish as they escape from the egg have been seen, and it has been the good fortune of Alexander Agassiz to succeed in hatching the eggs and raising the young until they showed at least the principal structural peculiarities of the adult. A short account of the chief facts in connection with this stage of the bony pike's history will appear in the forthcoming number of the *Proceedings* of the American Academy of Arts and Sciences; from an advance copy we cull the following details:

The spawning-ground selected for observation was the Black Lake, at Ogdensburg, N. Y. Mr. Garman, who describes the scene, and Mr. Blodgett, who rendered most essential assistance, deserve the thanks of every naturalist. The eggs collected were carried by the hand in pails from Ogdensburg to Cambridge, where their progress was watched by Prof. A. Agassiz.

The fish began to spawn about May 18. Little projections of granite stand out here and there into the lake. The frosts, from time to time, have broken off from these small angular blocks, which lie piled together under the water at depths varying from two to fourteen inches. Into these shallows the female fish would come, each of them attended by two males. While very timid when in deep water, they seemed to be courageous to recklessness when they approached the shallows. On they would come in threes, when rising to the surface of the water, and thrusting their bill out of it they would open this widely, then take in air, and close it with a snap. In some few cases three or four males would be in attendance on one female, but much more often there would be but two, and these would swim resting on either side of the female fish, their bills reaching up toward the back of her head. At times the water would be lashed into all directions with their conjoined convulsive movements. The eggs when laid were excessively sticky; to whatever they happened to touch they stuck, and so tenaciously, that it was next to impossible to release them without tearing away a portion of their envelopes. It is remarkable that, as far as could be seen, there was, on and about the spawning ground, a complete absence of anything that might serve as food for the young fish.

Of the quantity of eggs brought to Cambridge only thirty hatched, and not one of those artificially fecundated was hatched. In Prof. A. Agassiz's anxiety not to spoil this interesting experiment he did not venture to examine any of the fresh eggs, so that the history of their segmentation and very early development remains to be worked out. The envelope of the eggs is very opaque and of a yellowish green, like that of toads. Of the thirty hatched out by the end of May, twenty-eight were alive in the middle of July last. When first hatched the young fish possesses a gigantic yolk-bag, and the posterior part of the body presented nothing specially different from the general appearance of any ordinary bony (teleostean) fish of the same age; but the anterior part was most extraordinary: it looked like a huge mouth cavity, extending nearly to the gill opening, and crowned by a depression like a horse's hoof in outline, along the margin of which were a row of protuberances acting as suckers. The moment the young fish was hatched it attached itself to the sides of the vessel by means of these, and would hang immovable. The eye was not very advanced, the body was transparent, the gill covers were pressed against the sides of the body; the tail was slightly rounded, the embryonic fin was narrow, and there were no traces of embryonic fin rays; the olfactory lobes were greatly developed and elongated, as in sharks and skates; the chorda was straight. On the third day the body became covered with minute black pigment cells, and then was noted the first traces of the pectoral fins, and the snout became more elongated; the great yolk-bag was greatly reduced in size. About the fifth day were seen traces of the caudal, dorsal, and anal fins. Gradually the snout became elongated, the suckers concentrated, and the disproportionate size of the sucking disk became reduced, so that when about three weeks old it became altogether more fish-like. The sucking disk was now reduced to a swelling at the top of the upper jaw, the yolk-bag had disappeared, the gill covers extended well up to the base of the pectorals—these latter were in constant motion, and the tail exhibited the same rapid vibratile movements. The young fish now begins to swim about, and is not so dependent upon its sucking disk, and at last this only remains as a fleshy, globular termination on the snout. At this stage, too, the

* *Nature.*

young have the peculiar habit of the adult fish of coming to the surface to swallow air. When they go through the process under water of expiring this air they open their jaws wide and spread their gill-cover, and swallow as if they were choking, making violent efforts, until a minute bubble of air has become liberated, when they become quiet again. Their growth is rapid. Within a month the teeth made their appearance, and some of the fin-rays on the fringe of the pectorals were to be seen.

Prof. A. Agassiz draws the following conclusions from these observations: "That notwithstanding its similarity in certain stages of its growth to the sturgeon, notwithstanding its affinity with sharks by the formation of its pectorals from a lateral fold, as well as by the mode of growth of the gill openings and gill arches, the Lepidosteus is not at all so far removed as is generally supposed from the bony fishes." The memoir is illustrated by five plates containing some forty-five figures, and is only to be regarded as a preliminary account, but is a preliminary account of such exactness, importance, and interest, that no apology is necessary for bringing it at once under the notice of our readers. This memoir was presented to the American Academy as recently as October 8 last.

E. PERCEVAL WRIGHT.

[Continued from SUPPLEMENT 158, page 2520.]

PERUVIAN ANTIQUITIES.

By E. R. HEATH, M.D., Wyandotte, Kansas.

TEMPLES AND FORTRESSES.

THE square plateau first mentioned, at the base, consists of two divisions, one six feet lower than the other, but each measuring a perfect square 47 to 48 yards; the two joining form the square of 96 yds. Beside this, and a little forward on the western side, is another square 47 to 48 yards. On the top, returning again, we find the same symmetry of measurement in the multiples of twelve, nearly all the ruins in this valley being the same, which is a fact for the curious. Was it by accident or design? In its breadth from north to south, three levels are found. The first lower down, 17 to 18 yards wide; the second or highest summit, 59 to 60 yards across; and the third descent again, 23 to 24 yards. The mound is a truncated pyramidal form, and is calculated to contain a mass of 14,641,820 cubic feet of material. For the most part, this great work is composed of adobes, each six inches long, four inches wide, and two and a half inches thick, many having the marks of fingers on them. But this does not consist of more than one-third of the Pando huaca.

Walking down past the southern corner, where the adobes are tumbled into a conglomerate mass by some earthquake, we see skulls with bones of arms and legs, cropping up in many places. The same adobe work is visible throughout, and the whole length of these structures ranges between seven and eight hundred yards. The "Fortress" is a huge structure, 80 feet high, 148 to 150 yards in measurement. Great large square rooms show their outlines on the top, but are filled with earth. Who brought this earth here, and with what object was the filling up accomplished? The work of obliterating all space in these rooms with loose earth must have been almost as great as the construction of the building itself. About two miles south of the last named large fort, and in a parallel line with it as regards the sea, we find another similar structure, probably a little more spacious and with a greater number of apartments, or divisions by walls, on the top of which we can now walk, as it is likewise filled up with clay. This is called "San Miguel." It is nearly 170 yards in length, and 168 in breadth, and 98 feet high. The whole of these ruins, big fortress, small forts and temples, were inclosed by high walls of adobones, but all of wedge-shaped form, with the sharp edge upward. Adobones are large mud bricks, some from one to two yards in thickness, length and breadth. The huaca of the "Bell" contains about 20,220,840 cubic feet of material, while that of "San Miguel" has 25,650,800. These two buildings were constructed in the same style—having traces of terraces, parapets, and bastions, with a large number of rooms and squares—all now filled up with earth.

Near Lima, on the south, is another mound, 70 feet high and 153 yards square. Near the residence of Par Soldan, the Geographer of Peru, is a mound called "Sugar Loaf," or "San Isidro," 66 feet high, 80 yards broad at the base, and 130 yards long. Professor Raimondi, the naturalist, chemist and scientist, who is doing for Peru what Gay did for Chili, said he found nothing in it but bodies of ordinary fishermen, relics of nets, and some inferior specimens of pottery.

Prof. Steere and Dr. Hutchinson turned out about forty skulls, some bits of red and yellow dyed thread, being relics of cloth; a piece of string made of woman's hair, plaited, about the size of what is generally used for a watch guard; and pieces of very thick cotton cloth, bits of fish nets, portions of slings, and two specimens of crockery ware of excellent material.

About a mile beyond, in the direction of "Mira Flores," is Ocharan, the largest burial mound in the Huatica valley. This mound presents, as it is approached, the appearance of an imposing and enormous structure. It has 95 feet of elevation in its highest part, with an average width of 55 yards on the summit and a total length of 428 yards, or 1,284 feet, another multiple of twelve. It is inclosed by a double wall 816 yards in length by 700 across, thus inclosing 117 acres. Between Ocharan and the ocean are from 15 to 20 masses of ruins, like those already described.

THE GREAT TEMPLE OF THE SUN.

Fifteen miles south of Lima, in the valley of Lurin, and near the sea, are the ruins of Pacha Camac, the Inca Temple of the Sun. Like the temple of Cholula on the plains of Mexico, it is a sort of made mountain or vast terraced pyramid of earth. It is between two and three hundred feet high, and forms a semi-lunar shape, that is beyond a half mile in extent. Its top measures about ten acres square. Much of the walls are washed over with a red paint, probably ocher, and are as fresh and bright as when centuries ago it was first put on. In these walls in three or four places, are niches, apparently of the same shape and size as we see in the ruins of Pagan temples. From one side, going toward the north, are the relics of a wall, which is covered with soot, possibly the remnant of fires to make sacrifices, and nothing can better illustrate the conservative tendency of the Peruvian climate than the fresh appearance of the soot. Prescott says of Pacha Camac, that it was to the Peruvians what Mecca is to the Mahometan, and Cholula was to the Mexican.

In the Canete Valley, opposite the Chincha Guano Islands, are extensive ruins. In that region a terra-cotta mask was found, similar to that of which there is a drawing in Mr. Squiers' report of his explorations in the State of New York, and discovered while excavating for the St. Lawrence canal. From the hill called "Hill of Gold," copper and silver pins were taken like those used by ladies to pin their shawls; also, tweezers for pulling out the hair of the eye-brows, eye-lids, and whiskers, as well as silver cups.

Buried 62 feet under the ground on the Chincha Islands, stone idols and water pots were found, while 35 and 33 feet below the surface were wooden idols. Beneath the Guano on the Guañapi Islands, just south of Truxillo, and Macabi, just north, mummies, birds and birds' eggs, gold and silver ornaments were taken. On the Macabi the laborers found some large valuable golden vases, which they broke up and divided among themselves, even though offered weight for weight in gold coin, and thus have relics of greatest interest to the scientist been forever lost. He who can determine the centuries necessary to deposit thirty and sixty feet of guano on these islands, remembering that, since the conquest, three hundred years ago, no appreciable increase in depth has been noted, can give you an idea of the antiquity of these relics.

EFFECTS OF EARTHQUAKES.

The coast of Peru extends from Tumbez on the north to the River Loa on the south, a distance of 1,235 miles. Scattered here and there over this whole extent, there are thousands of ruins besides those just mentioned, and similar, only not so extensive; while nearly every hill and spur of the mountains has upon them or about them some relic of the past; and in every ravine from the coast to the central plateau, there are ruins of walls, fortresses, cities, burial vaults, and miles and miles of terraces and water courses. Across the plateau and down the eastern slope of the Andes to the home of the wild Indian, and into the unknown, impenetrable forest, still you find them. In 1861, Mendoza, in the Argentine Republic, a beautiful city on the plain, 45 miles from the foot of the Andes, in the short space of five minutes was a complete ruin, and 15,000 out of her 20,000 inhabitants, or 75 per cent., were in the arms of death. In 1871 it was still exactly as on the evening of her destruction; the miles of skeletons lying uncovered where they perished, and the streets yet obstructed with the debris of the fallen walls of the houses. A new city has been built beside the old one. Seeking a photograph of the ruins, I was told there were none. Persuading one of the artists to take some views of them, and going to see the proof, he told me he had been out all day and had done nothing, as he could find nothing to take "but a pile of dirt." Thus, also, you might, as most do, style these coast ruins, and those who live among them understand and appreciate them no better than did the Mendoza artist the ruins of that ill-fated city.

EXTRAORDINARY MOUNTAIN MASONRY.

In the mountains, however, where storms of rain and snow with terrific thunder and lightning are nearly constant a number of months each year, the ruins are different. Of granitic, porphyritic, lime and silicated sandstone, these massive, colossal, cyclopean structures have resisted the disintegration of time, geological transformations, earthquakes, and the sacrilegious, destructive hand of the warrior and treasure seeker. The masonry composing these walls, temples, houses, towers, fortresses, or sepulchers, is uncemented, held in place by the incline of the walls from the perpendicular, and adaptation of each stone to the place destined for it, the stones having from six to many sides, each dressed, and smoothed to fit another or others, with such exactness that the blade of a small pen knife cannot be inserted in any of the seams thus formed, whether in the central parts entirely hidden, or on the internal or external surfaces. These stones, selected with no reference to uniformity in shape or size, vary from one-half cubic foot to 1,500 cubic feet solid contents, and if, in the *many, many millions* of stones you could find *one* that would fit in the place of another, it would be purely accidental. In "Triumph Street," in the city of Cuzco, in a part of the wall of the ancient house of the Virgins of the Sun, is a very large stone, known as "the stone of the twelve corners," since it joins with those that surround it, by twelve faces, each having a different angle. Besides these twelve faces it has its external one, and no one knows how many it has on its back that is hidden in the masonry. In the wall of the center of the Cuzco fortress there are stones 13 feet high, 15 feet long, and 8 feet thick, and all having been quarried miles away. Near this city there is an oblong smooth bowlder 18 feet in its longer axis, and 12 in its lesser. On one side are large niches cut out, in which a man can stand, and by swaying his body cause the stone to rock. These niches apparently were made solely for this purpose. One of the most wonderful and extensive of these works in stone, is that called Ollantay-Tambo, a ruin situated thirty miles north of Cuzco, in a narrow ravine on the bank of the River Urubamba. It consists of a fortress constructed on the top of a sloping, craggy eminence. Extending from it to the plain below is a stone stairway. At the top of the stairway are six large slabs, twelve feet high, five feet wide, and three feet thick, side by side, having between them and on top narrow strips of stone about six inches wide, frames as it were to the slabs, and all being of dressed stone. At the bottom of the hill, part of which was made by hand, and at the foot of the stairs, a stone wall ten feet wide and twelve feet high extends some distance into the plain. In it are many niches, all facing the south.

The ruins on the islands in Lake Titicaca, where Incal history begins, have often been described.

At Tiahuanaco, a few miles south of the lake, there are stones in the form of columns, partly dressed, placed in line at certain distances from each other, and having an elevation above the ground of from eighteen to twenty feet. In this same line there is a monolithic doorway, now broken, ten feet high by thirteen wide. The space cut out for the door is seven feet four inches high, by three feet two inches wide. The whole face of the stone above the door is engraved. Another, similar, but smaller, lies on the ground beside it. These stones are of hard porphyry, and differ geologically from the surrounding rock, hence, we infer, they must have been brought from elsewhere.

At "Chavin de Huanta," a town in the province of Huari, there are some ruins worthy of note. The entrance to them is by an alley-way six feet wide and nine feet high, roofed over with sandstone partly dressed, of more than twelve feet in length. On each side there are rooms twelve feet wide, roofed by large pieces of sandstone one and a half feet thick and from six to nine feet wide. The walls of the rooms are six feet thick, and have some loop-holes in them, probably for ventilation. In the floor of this passage there is a very narrow entrance to a subterranean passage that passes beneath the river to the other side. From this many huacos, stone drinking vessels, instruments of copper and silver, and a skeleton of an Indian sitting, were taken. The greater part of these ruins are situated over aqueducts. The bridge to these castles is made of three stones of dressed granite, twenty-four feet long, two feet wide by one and a half thick. Some of the granite stones are covered with hieroglyphics.

At Corralones, twenty-four miles from Arequipa, there are hieroglyphics engraved on masses of granite, which appear as if painted with chalk. There are figures of men, llamas, circles, parallelograms, letters, as an R and an O, and even remains of a system of astronomy.

At Huaytar, in the Province of Castro Virreina, there is an edifice with the same engravings.

At Nazca, in the Province of Ica, there are some wonderful ruins of aqueducts, four to five feet high and three feet wide, very straight, double walled, of unfinished stone, flagged on top.

At Quelap, not far from Chochapayas, there have lately been examined some extensive works. A wall of dressed stone 560 feet wide, 3,660 long, and 150 feet high. The lower part is solid. Another wall above this has 600 feet length, 500 width, and the same elevation of 150 feet. There are niches over both walls, three feet long, one and a half wide and thick, containing the remains of those ancient inhabitants, some naked, others enveloped in shawls of cotton of distinct colors, and well embroidered. Their legs were doubled so that the knees touched the chin, and the arms were wound about the legs. The wall has three uncovered doors, the right side of each being semi-circular, and the left angular. From the base an inclined plane ascends almost insensibly the 150 feet of elevation, having about midway a species of sentry box in stone. In the upper part there is an ingenious hiding place of dressed stone, having upon it a place for an overlook from which a great portion of the province can be seen. Following the entrances of the second and highest wall, there are other sepulchers like small ovens, six feet high and twenty-four in circumference, in their base are flags, upon which some cadavers reposed. On the north side there is, on the perpendicular rocky side of the mountain, a brick wall, having small windows 600 feet from the bottom. No reason for this, nor means of approach, can now be found. The skillful construction of utensils of gold and silver that were found here, the ingenuity and solidity of this gigantic work of dressed stone, make it, also, probably of pre-Incal date.

HALF A MILLION MILES OF WONDERFUL STONE MASONRY.

To support the inhabitants, it became necessary to cultivate every part of the land possible, and since the greater portion is mountainous, they could make no use of that land except by such means as they adopted, *i. e.*, by terraces. Along the side, at the base of a hill or mountain, a stone wall is laid from one to eight feet high, according to the slope, and earth filled in between it and the side of the mountain, till even with the wall. Having this level for a base, another wall is laid, and again earth filled in, and so on, tier above tier, as high as the place will permit. These are terraces. The summits of the mountains are saturated with water from the melting snow or winter rains. This, forming little streams, is guided over these terraces. Each terrace is divided into patches by making a little ridge of earth a few inches high all around them, inclosing places two feet by six, or eight feet by ten, and so on according to the size of the terrace. The top terrace is first flooded, the ridge of earth serving as a dam. When it is considered wet enough, a channel is made by taking out a part of the ridge (with the hand or a little paddle about the size of a pancake turner), permitting the water to escape to the part below, flowing over the wall to the next terrace, which is similarly treated. But there are thousands of terraces where the mountains and hills are so low and near the rainless portion that snow never, and rain very seldom, moistens their summits, and where no one could expect water for irrigation unless carried there by hand. Starvation alone would compel people to undertake so fatiguing and laborious a work, especially in a country where the evenness of the climate tends to relax the energy of both mind and body. Estimating five hundred ravines in the twelve hundred miles of Peru, and ten miles of terraces of fifty tiers to each ravine, which would only be five miles of twenty-five tiers to each side, we have 250,000 miles of stone wall, averaging three to four feet high—enough to encircle this globe ten times. Surprising as these estimates may seem, I am fully convinced that an actual measurement would more than double them, for these ravines vary from thirty to one hundred miles in length, and ten miles to each is a low estimate. While at San Mateo, a town in the valley of the River Rimac, seventy-seven miles from the coast, where the mountains rise to a height of fifteen hundred or two thousand feet above the river bed, I counted two hundred tiers, none of which were less than four and many more than six miles long. Even at four miles, there would be at that point alone eight hundred miles of stone wall, and that only on one side of the ravine.

Who, then, were these people, cutting through sixty miles of granite, transporting blocks of hard porphyry, of Baalbic dimensions, miles from the place where quarried, across valleys thousands of feet deep, over mountains, along plains, leaving no trace of how or where they carried them; people ignorant of the use of iron, with the feeble llama their only beast of burden; who, after having brought these stones together and dressed them, fitted them into walls with mosaic precision; terracing thousands of miles of mountain side; building hills of adobes and earth, and huge cities; leaving works in clay, stone, copper, silver, gold, and embroidery, many of which cannot be duplicated at the present age; people apparently vying with Dives in riches, Hercules in strength and energy, and the ant and bee in industry?

ANCIENT PERUVIAN RECORDS.

Callao was submerged in 1746 and entirely destroyed. Lima was ruined in 1678—in 1746 only twenty houses out of three thousand were left standing—and again injured in 1764, 1822, and 1828, while the ancient cities in the Huatica and Lurin Valleys still remain in a comparatively good state of preservation. San Miguel de Piura, founded by Pizarro in 1531, was entirely destroyed in 1855, while the old ruins near by suffered little. Arequipa was thrown down in August, 1868, but the ruins near show no change.

Spanish writers refer all to Incal make, but Incal history only dates back to the eleventh century, and from that time to the Conquest is insufficient, nor do they speak of many of these works. It is granted that the Temple of the Sun, at Cuzco, was of Incal make, but that is the latest of the five styles of architecture visible in the Andes, each probably representing an age of human progress, therefore we are

pretty certain that the imperial glories of the Incas were but the last gleam of civilization that mounted up to thousands of years, that long before Manco Capac, the Andes had been the dwelling place of races whose beginnings must have been coeval with the savages of Western Europe. The gigantic architecture points to the Cyclopean family, the founders of the Temple of Babel and the Egyptian Pyramids. The Grecian scroll found in many places, borrowed from the Egyptians; the mode of burial and embalming their dead, points to Egypt as their similar; while the distaff, plow, manner of thrashing, and of making brick, are the same as when the Israelites were captives.

The hieroglyphics, to none of which as yet a key has been found, cannot be referred to the Incas, since they apparently had no knowledge of characters, but kept their records and accounts by means of a quippus, or knots, and different colored threads, as did those in Asia, China, Mexico, and Canada in ancient times, and they kept in each city an official whose business it was to keep and decipher their quippus. It was made of twisted wool, and consisted of a thread or thick string, from one to eighteen feet long, as a base upon which other threads or strings were attached. The different colors had different significations: the red, soldier or warrior; the yellow, gold; the white, silver or peace; the green, wheat or corn, and so on. In numerals, one knot signified ten; two simple knots, twenty; the knot doubly interlaced, one hundred; trebly interlaced, one thousand; two interlacings of this latter, two thousand. By setting apart a quippus for the military, another for laws and decrees, another for historic events, *i. e.*, a separate quippus for distinct classes of ideas—the same knots could be used many times over, but to read them one must know to which class they belonged.

Certain signs were affixed to the beginning of each "mother-thread," as the base or principal string was called, by which the official could distinguish each; however, should an official visit another locality, these signs had to be explained verbally, also the signs representing local events, names of rivers, mountains, ships, cities, etc. Hence, a quippus was only intelligible, for the most part, in the place it was kept. Many quippus have been taken from the graves in excellent state of preservation in color and texture, but the lips that alone could pronounce the verbal key have forever ceased their function, and the relic seeker has failed to note the exact spot where each was found, so that the records which could tell so much we want to know will remain sealed till all is revealed at the last day.

The skulls taken from the burial grounds, according to craniologists, represent three distinct races.

The first, to which the name "Chinchas" has been given, occupied the western part of Peru from the Andes to the Pacific, and from Tunebez on the north to the desert of Atacama on the south.

The second, called "Aymaras," dwelt in the elevated plains of Peru and Bolivia, on the southern shore of Lake Titicaca, where they reside even to this day, being the only race that did not give up their language for the Inichua, or language of the Incas, when conquered by them.

The third, called "Huancas," occupied the plateau between the chains of Andes north of Lake Titicaca to the 9th degree of south latitude. This race were supposed to have caused the peculiar shape of their heads by mechanical means, as the Flathead Indians with us, and the Conibcs, a tribe that now live on the banks of the Ucayali, near Sarayacu, but the taking from a mummy of a fœtus of seven or eight months having the same configuration of the skull has placed a doubt as to the certainty of this fact.

How changed! How fallen from their greatness must have been the Incas, when a little band of one hundred and sixty men could penetrate uninjured to their mountain homes, murder their worshiped kings and thousands of their warriors, and carry away their riches, and that, too, in a country where a few men with stones could resist successfully an army! Who could recognize in the present Inichua and Aymara Indians their noble ancestry?

Their songs are typical of their condition, and are called "tristes," or sad songs. Always a duet in a minor key, and at night as you hear it, it seems rather the expiring wail of some lost spirit than a human voice. It begins with a full inspiration of the lungs and at the highest pitch of the voice, and ends with the expiration of the breath in a low, long drawn out "andante pianissimo." The words are chanted and often made up for the occasion. These are the words heard by a traveler from the lips of a young Indian mother, in the wild recesses of the Andes:

"My mother begat me amid rain and mist,
To weep like the rain and be drifted like the clouds.
You are born in the cradle of sorrow,
Says my mother; and she weeps as she wraps me around.
If I wander the wide world over,
I could not meet my equal in misery.
Accursed be the day of my birth,
Accursed be the night I was born,
From this time, for ever and ever!"

GEOLOGICAL CHANGES.

Three times the Andes sank hundreds of feet beneath the ocean level, and again were slowly brought to their present height. A man's life would be too short to count even the centuries consumed in this operation. The coast of Peru has risen eighty feet since it felt the tread of Pizarro. Supposing the Andes to have risen uniformly and without interruption, seventy thousand years must have elapsed before they reached their present altitude.

Who knows, then, but that Jules Verne's fanciful idea regarding the lost continent, Atlanta, may be near the truth? Who can say that, where now is the Atlantic ocean, formerly did not exist a continent, with its dense population, advanced in the arts and sciences, who, as they found their land sinking beneath the waters, retired, part east and part west, populating thus the two new hemispheres? This would explain the similarity of their archæological structures and races and their differences, modified by and adapted to the character of their respective climates and countries. Thus could the llama and camel differ, although of the same species; thus the algoraba and espino trees; thus the Iroquois Indians of North America and the most ancient Arabs call the constellation of the "Great Bear" by the same name; thus various nations, cut off from all intercourse or knowledge of each other, divide the Zodiac in twelve constellations, apply to them the same names, and the northern Hindoos apply the name Andes to their Himalayan mountains, as did the South Americans to their principal chain. Must we fall in the old rut and suppose no other means of populating the Western Hemisphere except "by way of Behring's Strait?" Must we still locate a geographical Eden in the East, and suppose a land equally adapted to man, and as old geologically, must wait the aimless wanderings of the "lost tribe of Israel" to become populated?

Beside dead and speechless relics of the past there exists a living antiquity. In 7° south latitude, a couple of miles from the sea, there is a town of about 4,000 inhabitants called Eten. They speak, besides the Spanish, a language that some of the recently brought over Chinese laborers understand, but differ in all other respects. They intermarry brothers and sisters, uncles and nieces, nephews and aunts, *i. e.*, promiscuously, with no apparent curse of consanguinity. They are exclusive, permitting no intermarriage into their number or with the outside world. They have laws and customs and dress of their own, and live by braiding hats, mats, and weaving cloths. They will give no account of when they came or from whence, nor does history mention them as existing before the Spaniards came, nor does it record their arrival since. Among them you will find no sick or deformed people, their custom being to send a committee to each sick or old person, and if they judge the patient past recovery, or the aged past usefulness, the public executioner is sent and they are strangled. Eten orders it, they say, and none ever interfere with these orders.

Thirteen thousand years ago *Vega*, or *a Lyræ*, was the north polar star. Since then how many changes has she seen on our planet? How many nations and races spring into life, rise to their zenith splendor and then decay; and when we shall have been gone thirteen thousand years, and once more she resumes her post at the north, completing a "Platonic, or Great Year," think you that those who shall fill our places on the earth at that time will be more conversant with our history than we are of those that are passed? Verily might we exclaim in terms almost Psalmistic, "Great God, Creator and Director of the Universe, what is man that Thou art mindful of him!"—*Kansas Review.*

MISCELLANEOUS USEFUL RECEIPTS.

To Make Skeleton Leaves.—Place the leaves in a little rain water, to which a trace of yeast has been added. Allow the fermentation to proceed until the membranous portion becomes soft and easily washed away in a stream of water. They are bleached by dipping for a few minutes in a strong aqueous solution of sulphurous acid gas, or exposing them (while moist) in a box filled with the vapor of burning sulphur.

To Preserve Autumn Leaves.—Spread the fresh leaves and press them in a suitable dish, with alternate layers of fine sand, which is thoroughly dry and as hot as the hand can bear. When the sand has cooled they may be removed, smoothed under a hot iron, dipped for a moment in clear French spirit varnish, and allowed to dry in the air. By many melted white wax or paraffin is preferred to the varnish. These latter must not be too hot.

Academy Board, Smooth.—Apply to junk board a coating of size; when dry, spread on thick paint with a pallet knife.

Academy Board, Rough.—Size heavy Manila paper, apply to two sheets a thick coat of paint, place the painted sides together, then pull them apart. This will give the board a roughened surface or tooth.

Fumigating Paper.—Apply to bibulous paper a strong ethereal or alcoholic solution of benzoin, tolu, storax, olibanum or labdanum. To burn well the paper should first be impregnated with an aqueous solution of niter, and dried.

Soluble Blue.—Mix 1 lb. of dry Prussian blue with a little hot water to form a paste, and triturate this with about 1½ oz. of potassium ferrocyanide (yellow Prussiate), and allow it to dry.

Paste for Scrap Books.—Rice starch, 1 oz.; gelatin, 3 drachms; water, ½ pint; heat, with constant stirring, until the milky liquid becomes thick and glassy, when the paste is ready. Keep the paste in a tight bottle with a few drops of clove oil.

Gelatin Moulds for Plaster Casts.—Soften glue by digesting it in cold water and then melt it in a water bath. To the thick paste thus formed, add the same quantity by weight as that of the dry glue. The mass is then further heated and stirred for some time in order to evaporate the excess of water. This mixture does not adhere to well-oiled moulds, and is very elastic when cold.

Babbitt Metal.—By weight 4 parts copper, 8 parts antimony, 96 parts tin.

Fusible Metal.—1. Bismuth, 8 parts; lead, 5 parts; tin, 3 parts; melt together. Melts below 212° Fah.—2. Bismuth, 2; lead, 5; tin, 3. Melts in boiling water.—3. Lead, 3; tin, 2; bismuth, 5. Melts at 197° Fah.

Phosphorescent Paint for Clock Dials and other Surfaces.—1. Heat strontium theo-sulphate for 15 minutes over a good Bunsen gas lamp and then for 5 minutes over a blast lamp. 2. Heat equal parts of strontium carbonate and lac sulphuris gently for 5 minutes, then strongly for 25 minutes over a Bunsen lamp; then, finally, over a blast lamp, for 5 minutes. 3. Precipitate strong aqueous solution of strontium chloride by means of sulphuric acid; dry the precipitate, and heat it to redness for some time in a current of hydrogen; then over a Bunsen lamp for 10 minutes and for 20 minutes over a blast lamp. Mix any of these with pure melted paraffin for use as a paint, and expose for a time to sunlight. The two former yield a greenish phosphorescence in the dark, the latter a bluish light.

Welding Horn.—Pieces of horn may be joined by heating the edges until they are quite soft, and pressing them together until they are cold.

To Stain Horn.—Red.—Soak in very dilute nitric acid for a few minutes, and apply a strong infusion of cochineal in aqua ammonia.

Green.—Steep in a solution of 2 parts of verdigris and 1 of sal ammoniac.

Blue.—Stain green, and then steep for a short time in a weak solution of sulphate of indigo, containing a little cream of tartar.

Yellow.—Steep them in a solution of lead acetate, and, then, after drying, in a solution of bichromate of potash.

Purple.—Use a strong aqueous solution of gold chloride.

Black.—Use nitrate of silver solution and expose to sunlight.

Brown.—Immerse in aqueous solution of potassium ferrocyanide dry, and treat with a hot dilute solution of copper sulphate.

Walnut Stain.—Water, 1 qt.; sal soda, ½ oz.; Vandyke brown, 2½ ozs.; potassium bichromate, ¼ to ½ oz.; boil for ten minutes, replacing water lost by evaporation. Use hot and allow the work to dry thoroughly before oiling or varnishing.

To Render Cloth Fire-Proof.—Steep the fabric in almost any saline solution, such as borax, alum, sal-ammoniac, etc. The addition of about 1 oz. of alum or sal-ammoniac to the last water used to rinse a lady's dress, or set of bed furniture; or the addition of a less quantity to the starch used to stiffen them, renders them uninflammable, or at least so little combustible that they will not readily take fire, and if kindled, will not burst into flame.

Waterproofing Cloth.—Cloth coated with linseed oil to which a little wax and litharge have been added, will be water-proof.

To Render Fabrics Waterproof.—Saturate the goods with a strong hot aqueous solution of good resin soap, and then wring, transfer, and digest them in a second bath of alum or aluminum sulphate or acetate, dissolved in hot water. Rinse and dry thoroughly at a temperature of about 80° Fah. Thus treated the fibers do not readily absorb water, but the goods are not absolutely waterproof.

Moth and Roach Exterminator.—1. Benzine is said to be more effective than anything else for exterminating moths, roaches, etc. 2. A little alum or borax solution in hot water injected into the cracks and applied by a cloth to the wood work in the vicinity of these hiding places is usually effectual.

To Color Butter.—Use a little annatto; if pure it is not injurious.

To Remove Stains from Marble.—Cover the soiled part with a paste of quicklime, moistened with a strong aqueous solution of sal soda for several hours; then remove the paste, wash the parts thoroughly, and polish if necessary.

To Relieve Casks from Mustiness.—Burn a little sulphur in the empty casks, bung, and let them stand for a day.

Sticky Fly Paper.—Boiled linseed oil and resin; melt and add honey. Soak the paper in a strong solution of alum and then dry before applying the above.

CHEMICAL NOVELTIES.

Oxidation of Hydrocarbons.—Herran and Morel propose the following general method for the oxidation of hydrocarbons and carbureted products, and for their application. This process finds its most direct application in the manufacture of phthalic acid, anthraquinone, alizarine, purpurine, etc. It consists in taking any hydrocarbon, and heating it with a nitrate decomposable at low temperature by heat alone, or with a nitrate more stable but decomposable in presence of some other substance which is added. Thus nitrate of soda may be mixed with sulphate of iron or alumina.

In order to prepare phthalic acid, naphthaline is mixed either with nitrate of iron or alumina, or with a mixture of nitrate of soda and copperas, and heated gently. The nitrate is decomposed, oxidizes the naphthaline, and yields phthalic acid, which combines with the base of the decomposed nitrate to form a series of phthalates, some of which are coloring matters. On treating anthracene in the same manner we may obtain, according to the proportions and the nature of the nitrates employed, either anthraquinone, or more advanced products of oxidation.

Irorite or Artificial Ivory.—Sieger adds 2 parts of mastic, and 1 part of linseed oil varnish, to 100 parts of collodion, and when completely dissolved agitates strongly. Successive layers of this are then applied upon wood, paper, etc., allowing each coat to dry for 12 hours before another is applied. The surface is then polished in the same manner as ivory. Black designs printed upon this surface have the appearance of ebony inlaid work upon ivory.

Artificial Fuel.—Hes proposes the following strange mixture for artificial fuel: 125 parts sifted peat, 10 parts river mud, 1,000 parts anthracite dust, and 100 parts residues of schist-oils, or 120 parts of dry coal pitch.

A New Gum.—J. T. Way announces a mineral gum, which is to be a complete substitute for gum arabic, glue, etc., for all purposes, and, in combination with gypsum, may serve for a cement. He moistens 380 lbs. rodonda phosphate with 15 gallons of water, and adds 10 gallons of sulphuric acid of specific gravity 1·60, previously diluted with 35 gallons of water. The entire mixture is boiled for some hours, till the liquid has the specific gravity 3·10—a degree, by the way, which is marked on no hydrometer. It is then filtered through a Needham press, and the liquid is further concentrated to 1·45. During this concentration it is capable of taking up more phospate, which is accordingly added during the process of evaporation. Any excess of acid is removed with lime. Phosphoric acid may be used instead of sulphuric acid. (How will this act as a thickener ?)

New Colors.—Reinhold Hoffmann treats blue, green, or so-called white ultramarine at an elevated temperature, and with access of air with acids, or with salts which give off acids when heated. He thus obtains purple-red or violet colors, which, on further treatment in the same manner; become red.

Cacao Colors.—Alfred Michel prepares a brown color from cacao-shells. The shells are steeped in soft water, with or without sulphuric acid. They are then washed and treated with a strong soda-lye. From this solution the coloring matter is precipitated with an acid, or an acid metallic salt. The pure coloring matter is thrown on a filter and well washed. It forms a deep reddish-brown paste, drying up to a black-brown mass, and if dried at 212° Fahr. yields from 20 to 25 per cent. of the shells.

Morine.—The firm of Joseph Nowack's Sons & Carl Benda, of Lhotka, propose the following method of preparing morine and cotinine: 100 parts of ground fustic or young fustic is extracted at a boil, with 4½ parts of soda crystals, dissolved in 500 parts of water, and the liquor is evaporated down to 1·040 specific gravity (= 8° Twaddell). The liquor is clear at first, but gradually becomes turbid, and, on cooling, deposits the coloring matters, which are separated from the mother liquor by filtration. The liquid is again treated with soda, evaporated down to the above-mentioned strength, let cool, and filtered off from the deposit. This operation is repeated till no further sediment can be obtained. The coloring matter thus prepared is said to have sixty times as great tinctorial power as the original power.

[We doubt whether this invention could be made the subject of a valid patent in England. To our certain knowledge, as far back as the year 1860, dye-woods have been extracted with weak alkaline liquids, and deposits have been obtained from such extracts either by concentration or by the cautious addition of acids.—*Ed. Chemical Review.*